VOLVME VI
JAN. 1897
No. 1

THE BRICKBVILDER

OFFICE 85 WATER STREET BOSTON

THE BRICKBUILDER.

AN ILLUSTRATED MONTHLY DEVOTED TO THE ADVANCEMENT OF ARCHITECTURE IN MATERIALS OF CLAY.

PUBLISHED BY

ROGERS & MANSON,

CUSHING BUILDING, 85 WATER STREET, BOSTON.

P. O. BOX 3282.

Subscription price, mailed flat to subscribers in the United States and Canada	. . . . .	$2.50 per year
Single numbers	. . . .	25 cents
To countries in the Postal Union	. . . . .	$3.50 per year

Entered at the Boston, Mass., Post Office as Second Class Mail Matter, March 12, 1892.

THE BRICKBUILDER is for sale by all Newsdealers in the United States and Canada. Trade Supplied by the American News Co. and its branches.

PUBLISHERS' STATEMENT.

No person, firm, or corporation, interested directly or indirectly in the production or sale of building materials of any sort, has any connection, editorial or proprietary, with this publication.

THE BRICKBUILDER is published the 20th of each month.

AT the possible risk of wearying some of our readers, we feel constrained to recur to a subject of which we have frequently spoken in these pages, viz.: the consideration of bond in brickwork and the necessity of a uniform size for bricks. It is a melancholy and somewhat humiliating fact that under existing conditions the quality of brickwork is — all things considered — probably worse in America than in any other civilized country, while the quality of bricks is often better than elsewhere. All know our usual methods of building brick walls. The interior partition and bearing walls are invariably built with no less than four, oftener six or seven, courses, all stretchers followed by one course of headers, the resulting bond being necessarily very imperfect. As the mortar is frequently of poor quality, the wall so built has very little transverse strength. In case of fire, the falling beams frequently bring considerable lateral pressure to bear upon the walls, and our brick walls are frequently overthrown in fires, when walls, properly built and bonded, would stand and check the fire. There can be no doubt that the greater destruction caused by fires in this country, even in our masonry buildings, is largely to be ascribed to this cause. No one factor is more important in fighting fires, as every fire captain would testify, than to have walls which can be depended upon to stand, and which will serve as ramparts against the fire. On this account lateral strength is usually more important than longitudinal strength in a wall. The bond in which transverse and longitudinal strength are equal is one cause of headers to two of stretchers; but even such a bond as this is almost never found in the interior walls of buildings in this country.

With regard to the exterior walls the case is even worse. Until quite recently, the ideal of an exterior brick wall was one of brick, carefully culled to give the greatest uniformity of color and laid all stretchers, the front skin of face brick tied to the backing only by cutting off occasional bricks at the back and tailing bricks in behind the cut brick into the backing, or by using hoop iron bond. In either case the tie is so slight that the facing adds practically nothing to the strength of the wall. Such a wall is as bad artistically as it is constructionally. The even and hardly visible jointing and the uniformity of color produce a surface absolutely devoid of character or interest, and without the charm of color, which comes naturally and inevitably where bricks are used without culling, and are laid with joints sufficiently wide to tell in the color scheme.

Of late, since our architects have been learning the beauty of color variety in brick, and the value of the jointing as an element in the color and texture of the wall, these walls of monotonous sameness have become less common. Not only have bricks of russet, buff, and other colors been introduced, but even the red bricks are very often laid without culling, as they ought always to be. The greater effectiveness and interest given to the appearance of a brick wall surface by the true English and Flemish bonds has also come to be appreciated, and these are more and more used in place of the insipid stretcher work which was invariable twenty years ago. Owing, however, to the fact that common bricks in this country are rarely made, as they ought to be, so that two headers with the intermediate joint will be just equal to a stretcher, it is difficult and expensive to make use of these bonds. The width of the brick in relation to its length is usually too short, and the result is that the strongest of these two bonds, the true English bond, can rarely be made use of, without cutting the brick to avoid the vertical joints coming over each other to the detriment of strength as well as appearance. For this reason the Flemish bond is more often employed; but even in this bond the headers can be brought over each other only with considerable pains.

An added difficulty arises from the fact that bricks from different kilns are of very different sizes; so that where a better grade of brick is desired for the facing, as is usually the case, it is difficult to find a brick for the backing that will bond with it and sometimes only by using a better quality of brick than is really required. These difficulties result too frequently in the vicious practise of building a face wall with a sham Flemish bond, the bricks being cut in half to form sham headers, true headers being used only every three or four courses where the courses of the facing and of the backing happen to come to the same level, or sometimes headers are inserted when the two are not quite on a level, and the outer skin, being so largely independent of the backing, settles a little differently and the few headers are cracked in two by uneven settling. All this encourages the bricklayer in slipshod, careless, and unworkmanlike methods. He has little or no opportunity to show what he is really capable of, or to become really interested in the finer points of his craft, such as the laying of the more complicated bonds or brick pattern work. Indeed, he hardly even masters the laying of good English and Flemish bond, so that these are more expensive to lay than they ought to be from sheer unfamiliarity of the workman as well from the unnecessary difficulties resulting from the uneven sizes and bad shapes of the brick. All this group of difficulties harks back to the one fruitful source of the trouble: the fact that brick manufacturers have not been able to

agree upon, and rigidly adhere to, a proper standard size of brick which should apply to face-brick and common brick alike. No doubt some manufacturers purposely make their brick undersized, in order to sell a larger number, but such men are a small minority, we are glad to believe.

It is within the power of the manufacturers to combine and enforce a proper standard size. The difficulty of making allowance for differences of shrinkage in different clays is not insurmountable. Such a policy rigidly carried out would greatly encourage the use of brick and would bring about its employment in many cases where stone is now employed on the one hand, and where wood is employed at the other end of the scale. We are sure the architects would encourage such a movement by specifying standard size brick if they could readily be obtained. We wish the manufacturers could see that their own best interest lies this way, that they could greatly increase the use of brick by such a policy. The makers of pressed brick would find it to their interest to bring pressure to bear on the makers of common brick to adopt the standard size. We are sure that in this way the use of pressed brick would be increased. The better work that would result from the proper bonding between face and backing would make brick walls more durable than they now are. We are sure a rich harvest is in store for those who inaugurate the reform, and who bring it to the attention of architects.

PERSONAL AND CLUB NEWS.

MR. H. W. BUEMMING, architect, has opened an office in the Pabst Building, Milwaukee.

MR. GOULD has retired from the firm of Gould, Angell & Swift, architects, Providence, R. I. Messrs. Angell & Swift will continue the business at the same office.

RECENT events at the Chicago Architectural Club: December 28, annual Christmas-tree celebration; January 4, paper by R. E. Richardson, explaining the electrical terms and conditions as met with by architects; January 11, reception; Messrs. W. H. Eggebrecht, H. D. Jenkins, and E. S. Seney acting as hosts.

AT the annual meeting of the St. Louis Architectural Club, held January 2, the following officers were elected: President, W. B. Ittner; first vice, Ernest Helfensteller; second vice, J. C. Stephens; secretary, G. F. A. Breuggeman; treasurer, C. H. Dietering. These with Oscar Enders and J. L. Gray will constitute the executive board.

THE first regular meeting of the Pittsburg Architectural Club was held in their new quarters, Carnegie Library Building, Wednesday evening, December 16. The following officers were elected: President, Frank A. Large; vice-president, Jno. T. Comes; secretary, Chas. I. Ingham; treasurer, Miss Elise A. Mercur. Executive committee: Chas. W. Tufts, Robert G. Dickson, Miss McMasters, H. Childs Hodgins. The constitution and by-laws submitted at a former meeting were adopted as drafted.

THE Twelfth Annual Exhibition of the Architectural League of New York will open February 20, in the building of the American Fine Arts Society, 215 West 57th Street, and continue to March 13 inclusive. Hours 10 A. M. to 6 P. M., 8 P. M. to 10 P. M. Sundays, 1 P. M. to 6 P. M. and 8 P. M. to 10 P. M.

Exhibit entry blanks returnable Monday, February 1.

Last day for reception of exhibits, Wednesday, February 10, 6 P. M.

THE New Jersey Society of Architects held its regular monthly meeting at the parlors of L. Achtel Stetter, Newark, N. J., on January 7. Assemblyman McArthur, of Jersey City, addressed the meeting regarding his proposed new State building law applying to cities of the first and second classes. After discussion the matter was referred back to the committee having it in charge.

WE have received the catalogue of the Architectural Exhibition held by the T Square Club at the Pennsylvania Academy of the Fine Arts, Philadelphia, in connection with the sixty-sixth annual exhibition of painting and sculpture. It is a publication creditable alike to the profession which makes it possible, and to the club which has brought together so much good material. The value of publications of this sort is very readily appreciated. Indeed, it is possible that as much general, tangible good is accomplished by the publication of the catalogue as by the holding of the exhibition, which it in part illustrates; for while the exhibition passes, and is apt to share the fate of most all architectural exhibitions in that the general public is not in evidence, the catalogue is a thing to be treasured and preserved in the architects' offices, and cannot fail to be an educational factor. This book adds to the laurels of the T Square Club, an organization which now easily ranks as one of the most active professional bodies in the country. This catalogue has one innovation in the shape of a very excellent color reproduction of the drawing of the doorway of Santa Paula, Seville, by A. C. Munoz. This is, as far as we know, the first instance of color being used in connection with an architectural catalogue, and it is very successful.

ILLUSTRATED ADVERTISEMENTS.

THE adjoining illustration shows the doorway to a residence in Brooklyn, N. Y., the whole of which is executed in terra-cotta and brick. Montrose W. Morris is the architect, and the work was made by the New York Architectural Terra-Cotta Company. In the advertisement of the company for this month, on page xxviii,

is shown the alternate of Mr. Aldrich's design which was premiated in the competition held by the company.

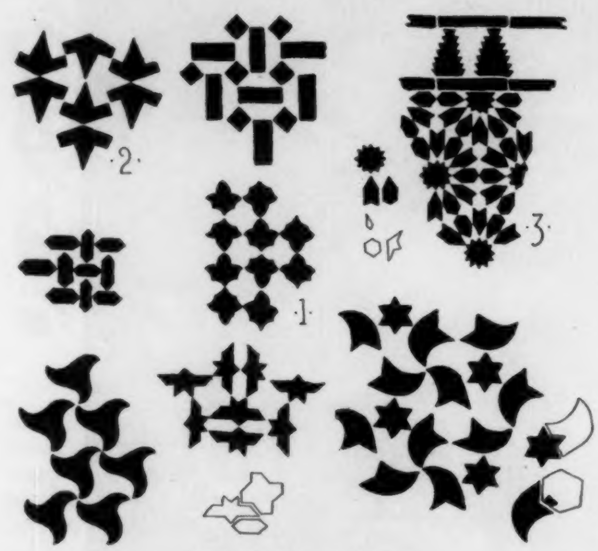
In the advertisement of R. Guastavino, page xiv, the fire-proof tile dome over the rotunda of the library for the University of Virginia is shown. The library is one of the group of new university buildings by McKim, Mead & White, and the illustration shows to good advantage Mr. Guastavino's system of fire-proof tiling.

A splendid illustration of Macmonnies' Bacchante, which was presented by Mr. Charles F. McKim to the Boston Public Library, is shown in the advertisement of Mr. F. B. Gilbreth on page xxxiv.

Spanish Brick and Tile Work. IV.

BY C. H. BLACKALL.

SINCE the publication of the last paper upon this subject, the writer has been able to verify his expressed surmise in regard to the character of the work in the doorway of Santa Paula, at Seville. The faience was modeled by one of the most promising pupils of the Della Robbias, who established himself in Spain after a long course of study in Italy. While this does not add to the artistic merit of the work, the fact is of interest.

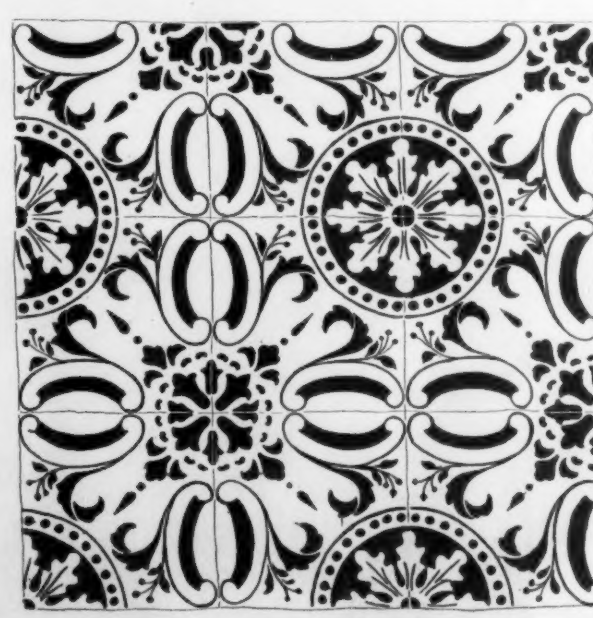


MOORISH TILE PATTERNS.

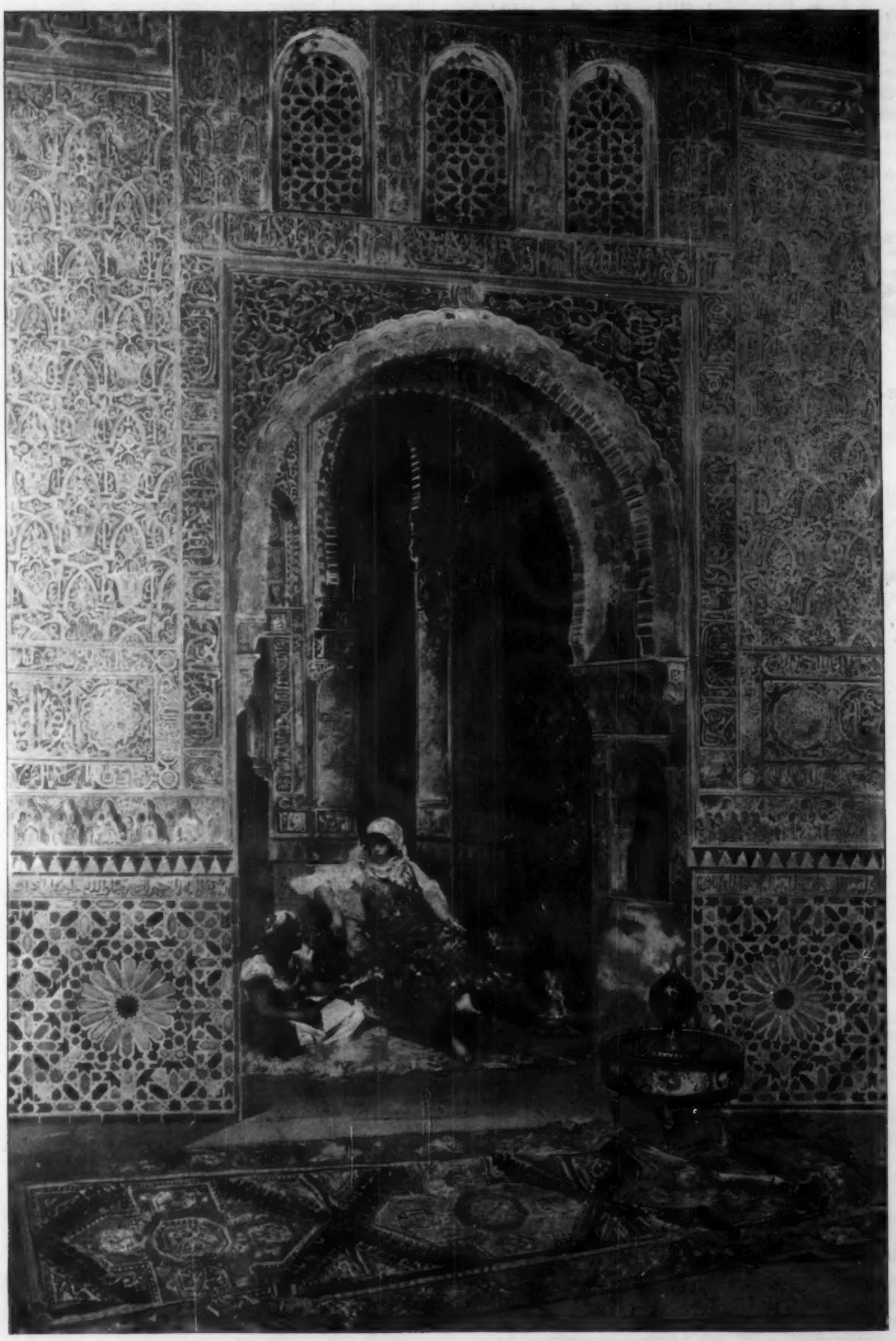
There remains only one manifestation of Spanish ceramic art to be included within the scope of this paper, namely, the enameled tiling. It is hard to speak dispassionately of Spanish tiles. From a practical standpoint they leave a great deal to be desired, as the workmanship is almost invariably crude and the enamel is applied to a very inferior grade of terra-cotta; but in an artistic sense it is doubtful if the world has ever seen ceramic work which was, on the whole, so eminently successful; and with the exception of what has been accomplished by the Persians and by a few of the Northern races in India, there are no other encaustic or enameled tiles known to us at present which can approach the Spanish work for brilliancy of design combined with a strictly decorative treatment of mass and a harmony of colors. All periods of modern art have been inspired very directly by these wonderful creations. The very term "Majolica" comes from the name of an island lying off the coast of Spain, in which the fabrication of vitreous enamels at an early period of modern history began to assume a high importance, and from whence the secret of the manufacture was spread over Europe. All of the Semitic races have been inclined to tile work, and even as far back as the days of the Assyrian monarchies encaustic tiling was a recognized and very successful medium of adornment, while the enamels and potteries of Damascus, of lower Egypt, of Bagdad, and of Ispahan, have been prized by artists and collectors for many generations. It is then not strange that the Moors, who inherited the artistic tendencies of their Asiatic forbears, should, when removed to the security of the Spanish Moslem empire, with ample means at command and a degree of security from external political complications such as the Arab races never enjoyed elsewhere, be able to carry their decorative tendencies to the highest perfection. Moorish art was a matter almost purely of detail, and, owing to the peculiar, seclusive manner of life which this strange race preserved for so many centuries, there are very few manifestations of external architecture or decorative art. There are a few instances, such as the exquisite structure in the enclosure of the Alhambra, known as the Wine Gate, in which a species of external ceramic treatment was tried by the Moors; but, as a rule, the exteriors of the buildings erected by them were somber and uninteresting, and the lavish imaginative qualities of their arts and sciences were reserved for the privacy of the interior.

The Moorish tiles were formed from a stiff but not very hard clay, which was squeezed into molds so that the individual pieces were slightly beveled on the edges towards the back, permitting of very fine joints, if such were desired, though more commonly the tiles were so bedded in a matrix of mortar as to leave broad and somewhat irregular joints, the bevel of the tile allowing the mortar to key thoroughly around each piece. The colors were applied in the shape of enamels, rarely any glazes or transparent colors being used. In the early Moorish work, tiling, whether for dados or floors, was treated purely as a mosaic, a pattern being evolved by the combination of a few forms repeated in a geometrical arrangement. Thus, in Fig. 1, the pattern is made by only two tiles of different colors. Figs. 2 and 3 are likewise made with a single shape in different colors, and even so complicated a pattern as the one shown by Fig. 3 requires only three forms of colored and three of white tiles to build up the entire design. In the later Moorish period the strictly mosaic treatment was abandoned, and we find tiles on which the patterns were stenciled over a white ground so as to reduce the manual labor of setting in place, while after the Christian conquest the tiles were frequently in slight relief, the pattern stamped in the moist clay and the impressions filled with the liquid enamel to produce the different effects of pattern and color. Attempts have frequently been made in recent years to copy the effects of the Moorish tiling, but while the raised and stenciled tiles can easily be adapted to our present conditions, it would require at least a generation of education to so train our mechanics as to be able to set the intricate mosaics which the early Moors used so constantly for their walls and floors; and aside from any question of expense, which would be a considerable factor, it would hardly be practicable to undertake to reproduce the Moorish tiles in our work.

The colors of the Moorish tiles are mostly green, blue, black, white, and yellow, the green, white, and black combination largely predominating. There seems to be very little variety in tones used, as the colors are practically the same in nearly all the Moorish work

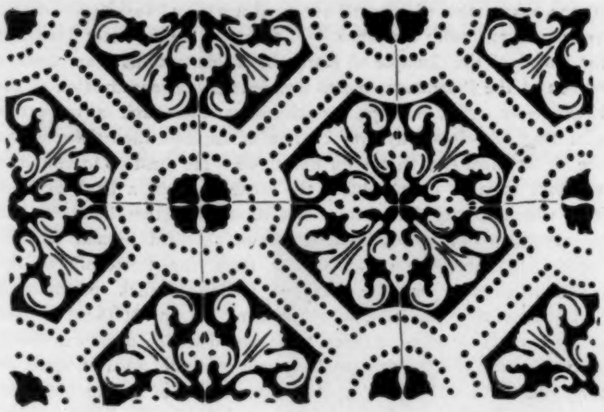


PATTERN OF EXTERIOR WALL TILES FROM LISBON.



INTERIOR OF TOWER OF THE CAPTIVE, THE ALHAMBRA.

now remaining, the variety of treatment and diversity of effect having been produced entirely by changes in the pattern or in disposition of colors. There are two groups of buildings which are preeminent among the existing examples of Moorish construction wherein tiles were used for decorative treatment. The Alcazar at Seville is one of the royal residences which was erected by Moorish workmen for the



PATTERN OF EXTERIOR WALL TILES FROM LISBON.

early Christian conquerors; and although it is not, strictly speaking, a Moorish product by ownership, it is such by the character of the work, debarring a few of the more modern changes. This building has been very carefully restored, is kept in exquisite repair, and serves as perhaps, on the whole, the best example in which the Moorish styles can be studied, though the treatment in a decorative sense is not as pure as in some of the other instances. The interior consists of a vast succession of apartments grouped around interior courts, the whole ornamented with lavish Moorish details, and with a wealth of tiling in the shape of wainscotting and paving, all of which is, in an artist's sense, none the less entertaining because of the rococo additions of later date or the charming tropical gardens which close the vistas of the broad halls.

The Alhambra of Granada is the structure which is most intimately associated with Moorish work. It is, properly speaking, a collection of buildings erected upon the spur of a hill jutting out into the valley above the city, and includes a number of structures of different periods, which until quite recently were sadly dilapidated and almost totally neglected. Of late years, however, the Spanish government has restored a very considerable portion of the Moorish work in a most intelligent manner, and as far as concerns the details of design, the interior gives a very fair idea of what the Moors attempted to produce. Any one who has seen this work in place is sure to retain a very vivid impression of how it looks and what it is, but any attempt to describe it without the aid of color is almost hopeless; for while the Moors placed a great deal of insistence upon the design, and their keen geometric taste enabled them to evolve most surprising results with very simple motives, yet color was so essentially a part of the whole that mere black and white reproductions absolutely fail to convey exact impressions. Furthermore, it is to be doubted whether the Alhambra as it exists to-day in its most carefully restored portions can be a correct representation of Moorish art. The rooms are grouped around courts, and there is plenty of sunshine and a certain amount of green foliage at the end of each vista, so that surprises await one at every turn; and the succession of halls and corridors, with their enameled surfaces, is very fascinating; but the absence of life, the lack of fittings, make even this fairy-like palace seem very dreary. We all know how hopeless a new house seems before it is carpeted or furnished, and the same applies to this Moorish work; it needs surroundings, it needs life, and all the thousand and one little things which add personal interest, in order to be anywhere near appreciated. The view which is reproduced of the interior of the Tower of the Captive is from a very brilliant watercolor by G. Simoni, in "*Die Baukunst Spaniens*," and with the accessories so cleverly introduced, it gives, better than any photograph, an idea of what the Alhambra might be, in an inhabitable state.

Encaustic tile ceased to be used as a mosaic with the incoming of the Renaissance. The Spanish architects, however, produced some marvelously interesting work in this direction, and not only used tiles by themselves, but frequently carried ceramic painting to a very considerable extent. The illustration of the altar-piece and wall decoration is from one of the chapels of the cathedral at Seville. The whole of the decoration is in tile, and is one of the most ambitious examples of this particular phase of art which is in existence.

The extent of possible discussion of such a subject as this is almost without bounds, and I can accordingly only hint at the variety of treatment, the complexity of design, and the contrasts of color which result from the use of enameled tiles by the Moors and their successors in Spain. There is one manifestation, however, which I wish to notice. Lisbon is essentially Spanish in its art antecedents, and the ceramic manifestations of the Moors survive in Portugal to a greater extent than anywhere else on the peninsular. The street fronts of the houses are faced almost universally with enameled tiles. The idea is an excellent one; and properly developed, nothing more brilliant and interesting could be imagined than a long street, to say nothing of a whole city, clothed in all the beautiful hues which are to-day so easily produced by the ceramic artists. Plain white tiles are seldom used, though sometimes a single tone is employed. Blue is the color most employed, a blue pattern on a

ALTAR-PIECE, SEVILLE CATHEDRAL.

white ground, the tone being a cross between Delft and a French blue. The Portuguese have by no means perfected this mode of finish, or decoration, whichever it may be termed, although they have used it now for several centuries, and it is certainly a very interesting manifestation of possibilities.

Architectural Terra-Cotta.

BY THOMAS CUSACK.

(Continued.)

FROM the poetic to the severely practical may seem a long distance; in the present instance, however, it is but a step, such as the one we have now taken from the end of the last to the beginning of the present chapter. Thus far we have traced in sketchy outline the origin and application of burned clay from the building of Babel to the Christian era; thence through the Middle Ages, the Renaissance period, and onward to its modern revival in

FIG. 7. HOFFMAN LIBRARY, ST. STEPHEN'S COLLEGE.

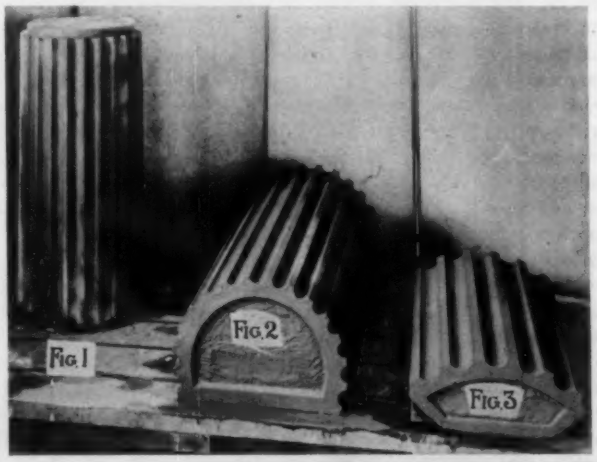
England, and subsequent introduction in America. We now take up the things of yesterday, to-day, and to-morrow, in this year of grace 1897, and we would fain hope, in a way that may prove helpful to those in whose hands lie its destiny in the coming century.

A time there was, and that not very long ago, when an architect having a desire to use terra-cotta was obliged to adopt some style admitting of comparatively small blocks. These he was advised to use in a more or less isolated manner, with brick filling as the connecting link. When not wholly detached, sundry expedients were frequently resorted to as a makeshift remedy for miscalculation in shrinkage, or, perhaps, a deviation from the figured dimensions in setting-out piers, openings, and breaks, etc., at the building. It was conceded, even by the manufacturers themselves, that in some instances the tail wagged the dog; and we fear that the practise, reprehensible though it be, has not yet been wholly abolished. This was merely yielding to difficulties, instead of adopting adequate means to overcome and finally end them. Available examples furnished by past ages were freely drawn upon, but failing to find a beau ideal from among them, the architect was expected to invent one suitable for immediate use. This he sometimes undertook to do, with remarkable promptitude but varying success. The mountain, he was informed, would not come to Mahomet, which for the nonce left the prophet but one alternative — pack his draughting paraphernalia, so to speak, and betake himself to the mountain. As a consequence, both design and construction were made subservient to the fancied as well as the real exigencies of the material. To some extent this is necessary,— for every material has its limitations,— but when it comes to fixing a standard of excellence by judicious compromise, we believe in leveling up rather than leveling down.

In the case of burned clay, however, everybody seemed inclined to capitulate, and allow this most excellent servant to become master of the situation. That undesirable state of things was not destined to last through an age of scientific research and mechanical invention. A race of men who have annihilated time and space by harnessing the unseen forces of nature, whether on land or sea, could not submit to the caprice of so simple an element. The action of fire upon a piece of selected and suitably prepared clay can be regulated and controlled with as much certainty as it can upon any other mineral. We state this advisedly, as a literal fact, and within certain limits, which we will hereafter endeavor to define; no competent architect need feel himself hedged in by irksome restraints, such as those to which he was at one time obliged to submit.

It is no longer a question of arbitrary style, having now resolved itself largely into one of treatment. Even in that there remains a world of latitude, in the hands of men who have profited by the observation of recently executed work, and feel an inclination to keep abreast with the times. Of course, if an architect has taken for his ideal the Temple of Karnack, or has set his heart upon a replica of the Parthenon, or has decided upon a reproduction of the Erechtheum, with, perhaps, monolithic columns and a trabeation admitting of joints only over centers of capitals, then there is but one, or at most two, things for him to do. He must go in search of a quarry capable of supplying the stones, and of a bank account from which to pay for them. But if, on the other hand, he can concentrate his ideas within the limits of classical Roman, Romanesque, Byzantine, Saracenic, Gothic from the thirteenth to the twentieth century, or any phase of Italian, French, or Spanish Renaissance, there is some hope for him. In any of these he can use terra-cotta throughout much as he would stone; or he can use it in combination with brick from basement to dome, minaret, spire, or campanile. All will depend upon his conception of these styles, and his way of handling any or all of them. One thing he must do: study the very wonderful capabilities of the material, without losing sight of its limitations. Great progress has been made by our best architects in these matters of late years. A large proportion of recent work bears the evidence of advanced thought and conscientious effort, usually in the right direction. Yet, judging from what we sometimes see done or attempted, there is still much to learn as to what may or may not be expected in the use of this material under given conditions. We hope, in succeeding pages, to contribute something towards a better understanding of the facts and principles underlying this aspect of the subject.

We are not writing for the behoof of men who, having failed in everything, take refuge behind a shingle of large size, on which has been painted the word ARCHITECT; by which magic name they seek to distinguish themselves from the great army of unemployed. They are past praying for. Our remarks are addressed primarily to men who have earned or are now earning their right to that title, and who have worn or intend to wear it honorably. We



therefore take for granted their wide acquaintance with the merits of material in general. This much is essential to success under any circumstances. But when the material to be used is largely terra-cotta, a more exact knowledge of its physical characteristics is indispensable. To know as much as may be about the whys and wherefores of its manufacture will likewise greatly help them in using it to architectural as well as to commercial advantage. To that

end, we will turn from the general to the particular application of these observations, and instance a number of difficult yet every-day problems confined to work that has been or can be executed successfully. Attention will also be directed to some of the things which (as yet) cannot be made satisfactorily in terra-cotta, and that being so, is to our mind a sufficient reason why they should not be attempted. Like most things, this branch of our subject has a negative as well as a positive side, and to be of any real value the treatment must be unreservedly frank as well as intensely practical.

> "I, from no building, gay or solemn,
> Can miss the shapely Grecian column."

We will therefore begin with the column, which, in its diverse manifestations, affords as good an illustration as any we can think of as to what can and what can *not* be accomplished in terra-cotta. One of the most troublesome things to make is a full column that will withstand critical inspection on all sides. The difficulties begin to increase when the diameter exceeds 1 ft.; beyond that, the point is soon reached when they become insurmountable. If it be a three-quarter column, with an engagement on every alternate block for building into wall, most of these difficulties disappear, and the diameter may be increased to as much as 2 ft. and still remain practicable. In the former case we are speaking of plain shafts, but when severely fluted, the trouble is obviously increased. This is because of the extreme accuracy with which the arrises of the fillets have to fit, and the trueness of line required to make them presentable to the eye on close inspection. Macaulay's inspired schoolboy may not have known of the nicety demanded in working these drums in stone or marble, but every stone and marble cutter does. And when they have done their utmost, a good deal of faking still remains to be done after the column has been set in its position. This paring is not permissible in terra-cotta; for once the fired surface has been broken, a patch takes the place of an irregularity, and the remedy is, if anything, worse than the disease.

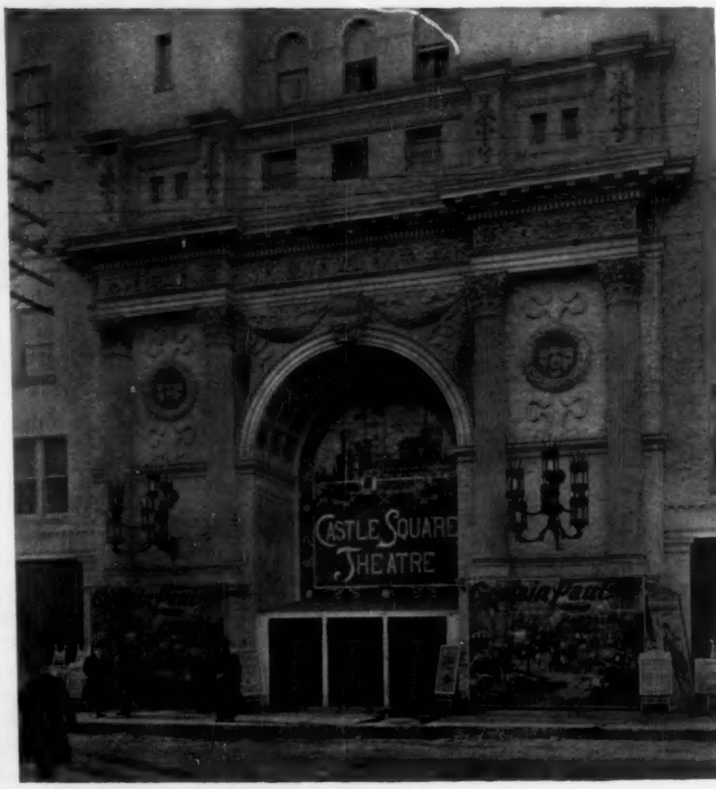


FIG. 4. ENTRANCE TO CASTLE SQUARE THEATER, BOSTON.

In the case of a 12 in. column with a height of, say, eight diameters, it would be jointed into five pieces, each weighing about 95 lbs. When the necessarily soft clay is pressed into a plaster mold, a proportion of the moisture is absorbed, and when ready for turning out to dry, it has acquired a considerable degree of stiffness. A safe-edge of $\frac{3}{4}$ in. has been allowed on each end, standing back about $\frac{1}{4}$ in. from the bottom of the flutes, to be trimmed off after burning. On this it is set to dry, first on one end, and then on the other, as shown on Fig. 1. Five eighths of the shrinkage takes place in the drying, and three eighths in the burning. In both cases the piece rests on a thin layer of coarse sand, each grain acting as a roller, which enables the circumference to travel more easily towards its center during the progress of contraction. But notwithstanding these and many other precautions, the weight of the piece, if it does not cause it to spread, is liable to impede the uniform shrinkage of the end on which it rests. Of course the greater the weight, the greater must be the impediment. If the column is jointed in three instead of in five (as architects will sometimes insist upon doing), the bottom third being parallel and the other two entasized, this burring on the ends is sure to happen. In that case the weight has been increased to 150 lbs. in a shaft of 12 ins. diameter, involving a corresponding uncertainty in fitting at the joints, as well as in the alignment of the pieces themselves.

But let us double the size of our column, viz., 2 ft. in which case it would be made (if made at all) in seven pieces of 2 ft. 8 ins. each. These would weigh 675 lbs., and, for the reasons just stated, may be considered altogether impracticable. If, however, "fools rush in," etc., as they sometimes will, and order a 2 ft. column complete drums without vertical joints, they may expect to pay for their enlightenment in regrets as endless as they will be useless. Some inexperienced manufacturer may take the order, and under pressure endeavor to go through with it, but in the end the architect will find that to order is one thing, but to execute is quite another matter.

In a three-quarter column, the conditions being reversed, the block can be turned out as at Fig. 2. The sanded board on which it lies being tilted to alternate ends at an angle of 30 degs., the shrinkage will be uniform, the block will be sound, and if reasonable care is exercised in its remaining vicissitudes, the ends will fit each other when set. A shaft of this kind can be made up to 2 ft. diameter, jointed in five pieces averaging 3 ft. 3 ins. long and weighing 700 lbs. But to make quite certain of the result, we would advise jointing it in seven pieces of 2 ft. 4 ins., thus reducing the weight to 490 lbs., and thereby securing a much greater uniformity in drying and burning. Four columns of this size and character are used on the Maryland Life Building, Baltimore, of which Mr. J. E. Sperry was the architect. In justice to him, however, we will say that he is not responsible for the jointing. Each shaft is jointed into twelve pieces, which are about five too many; and we cite this as an example to avoid, rather than one worthy of being followed. We are, of course, assuming a case in which it has been deemed imperative to make a column of this size in single blocks, without vertical joints, but do not wish to be understood as favoring that method.

Somewhat similar columns have since been made for the same architect, and are used on the Brewers' Exchange, Baltimore. They, however, are jointed vertically into alternating segments, one course being in two, and the next in three pieces, with the interior built of solid brickwork bonded into and forming part of the wall. The result is highly encouraging, and has given much satisfaction to the

architect. The same plan was adopted in constructing four attached columns used on the Castle Square Theater, Boston (Fig. 4). Messrs. Winslow & Wetherell were the architects in this case, and they, too, think the effect very successful.

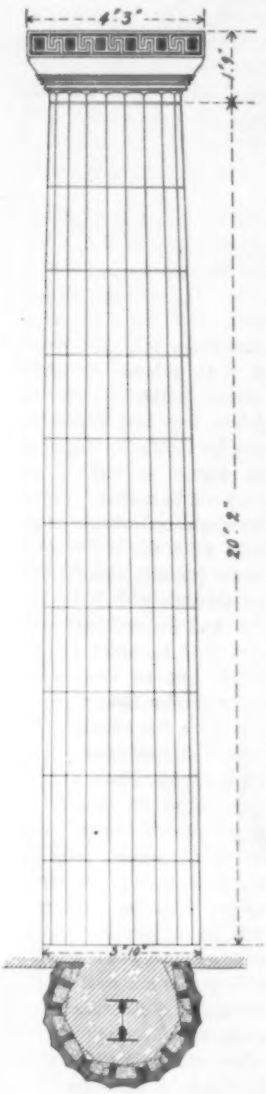


FIG. 5.

In Fig. 5 we illustrate the construction of a Doric column; the first of its kind that we have seen attempted in terra-cotta. Two of them are used on the fourteenth story of the Central Syndicate Building, Broadway and Pearl Street, New York City. It has been remarked that the Greeks did not use columns of this kind on the fourteenth story. Had they lived in New York, however, they would ere this have been confronted with a condition, not a theory, and in that case, there is no telling what they *might* have done. The dotted lines on plan show how the courses break bond and tie each other without the necessity of extraneous anchors. In addition to the iron stanchion in center, the core is filled in with brick and cement, as in the instances just mentioned. The result compares favorably with similar columns in granite used on the first story of the same building. Taken altogether, we think this successful example will settle any doubts that may have existed as to the feasibility of constructing a Doric column in terra-cotta.

A full column, when it exceeds, say 1 ft. 4 in. in diameter, should be jointed up in segments of four or six pieces, according to size, the vertical joints being in the center of the flute. The height of the segment should not be more than one and a half times its width, and may be from 4 to 8 ins. in thickness, the back being left perfectly flat, so that it may be dried on a level board, as at Fig. 3. Columns of 2 ft. 10 ins. diameter have been made in three segments on plan to satisfy the scruples of architect and owner, who had at first insisted on having them in complete drums. When this method is adopted and the piece turned out of mold, the vertical joints, being radial, form an angle with the board on which it rests. This overhang will cause the sides to sag unless temporary supports (to be cut off before burning) are placed at intervals in the angle, as seen in Fig. 3, which is a quadrant. In the case just referred to the segments were 2 ft. 6 ins. wide, 2 ft. 8 ins. in height, by about 8 ins. thick in the center, and the columns so constructed may now be seen on the Chapin Building, Buffalo. We have seen a letter from the architect, Mr. F. E. Kent, in which he speaks in the most eulogistic terms of these columns after they had been set.

In Fig. 6 we illustrate a column of about the same general proportions. It, however, is made in six segments, and with base and capital has a total of 118 pieces. It will be noticed that the flutes on the lower part are not filled with the usual convex billet, but are slightly recessed, the surface being struck from the same center as the column, for which see enlarged flute at D. The termination at top is also somewhat uncommon, but not without warrant, though this treatment has been criticized in the hearing of the writer as unauthorized. In reply he ventured to quote as a precedent the Chapelle San Bernardino, at Verona, in which are columns practically identical in both these respects. The joints are intentionally emphasized in the drawing, and the three accompanying plans will show the construction. The core being of brick, laid in cement and all the interstices grouted, we get a shaft capable of sustaining an immense weight. But should still greater stiffness be required, a cast-iron core or a polygon of riveted steel sections may be introduced, giving an almost unlimited strength. Twenty-six of these columns were used by Mr. C. C. Haight on the Hoffman Library, St. Stephen's College, a view of which we give (Fig. 7) from a recent photograph. (*To be continued.*)

IN the course of a recent visit to New York City, I had occasion to view the Park Avenue front of the Murray Hill Hotel, itself an erection of yesterday; yet judged by the dilapidated condition of the red sandstone, it might have been built by Diedrich Knickerbocker. This is about the center of the brownstone high stoop district, at one time the Mecca of successful tradesmen, and still the homes of the elect, when "at home." The balustrades, basement walling, water tables, window trimmings, and even the flat ashlar veneers appear to throw off a coat of scale, from one to three eighths of an inch in thickness, every year or two. I was informed that this occurs with great regularity, until the advent of the boarding-house keeper, after which decay becomes more rapid, and demolition the inevitable adieu. I traversed several of the crosstown streets, and the difference between them from 18th to 59th was merely one of degree, but all bearing a close approximation to their age, which is premature, being from five to fifty years. It is no uncommon thing to see one of these fronts pulled down and replaced with Philadelphia, or latterly, with Pompeian brick and terra-cotta. A brownstone church on 7th Avenue near 14th Street, which was built in 1856, has just been demolished and rebuilt in cream-white brick and terra-cotta to match.

A similar state of transformation is going on in the downtown sections. Stone and marble fronts that were the pride of a past generation are giving place to granite lower stories with superstructures of terra-cotta and brick, behind which is a sinuous anatomy of riveted steel. Thus does evolution in all things emphasize the survival of the fittest.— *Correspondent.*

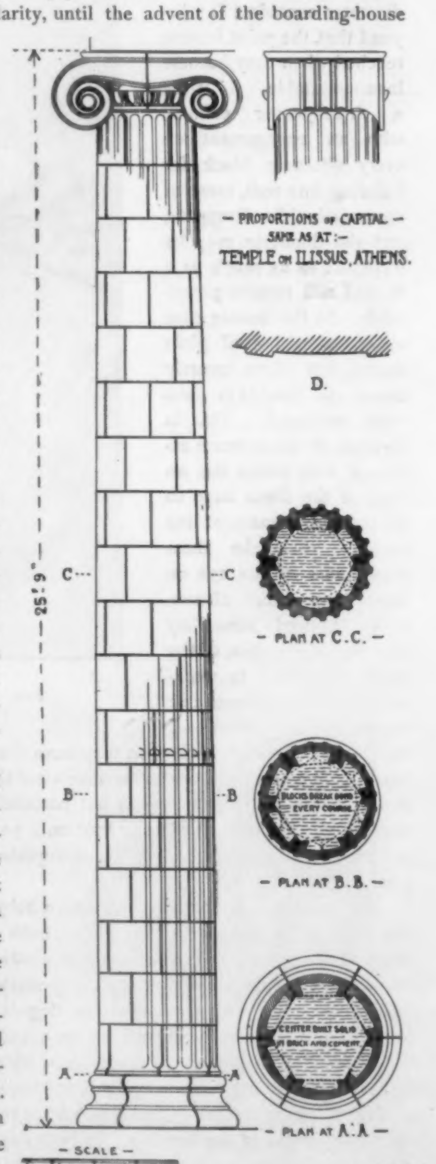


FIG. 6.

Fire-proofing Department.

SOME VALUABLE OPINIONS ON FIRE-PROOF CONSTRUCTION.

THE fire-proofing of our large commercial buildings is of such vital importance that, although as a science it is of quite modern development, its methods have of late years been the subject of many tests and special investigations made for the purpose of determining to what extent such precautions as are customarily taken serve their intended purpose. There have been several fires in buildings which are known commercially and scientifically as fire-proof structures, and though the actual damage resulting from such fires has, in most instances, been relatively quite slight, they have suggested very pertinent inquiry as to whether our materials are applied in the best and most scientific manner, and whether our fire-proofing systems are really fire-proof. Terra-cotta in one form or another has been very generally adopted for the protection of steel work and the construction of floors, and its properties and the details of its employment have received considerable study. With a view to determining the current opinion in regard to the use and the possibilities of terra-cotta, THE BRICKBUILDER has interviewed several of the leading architects in New York and Boston to ascertain whether in their judgment terra-cotta meets the requirements of the conditions of properly fire-proofing a building, and whether such a material, as a whole, can be depended upon.

Among those interviewed was Mr. George B. Post, of New York, who said that he considered sawdust or porous terra-cotta a most excellent material for resisting the combined action of fire and water, conditions which always arise in any burning building. In portions of the new twenty-five-story St. Paul Building on lower Broadway, and in the World Building, the Havemeyer, and in fact all of the large buildings which Mr. Post has erected, he has used the porous terra-cotta for fire-proof construction. Where the floor has to sustain a heavy direct load the end construction is the lightest and the strongest, but where lateral stiffness in the floors is desired, he believes the side construction to be the best adapted for the purpose. The ordinary builders, if left to themselves without the closest supervision, do not sufficiently fire-proof the floor openings in a building, and they are apt to ignore the fire-proofing of the girders. He believes, however, that the necessity for protecting the flanges of the beams is often exaggerated, and he cited the experience of the fire which a few years since burned out the upper stories of the building which he had erected for the Western Union Telegraph Company on Broadway. This fire originated in the low story which contained the batteries, and the heat was so intense that the granite window trimmings were destroyed and a couple of unprotected columns in the story were actually melted at their tops. The floor construction was of brick arches turned between the beams, and the lower flanges of the beams were protected by only five eighths of an inch of plaster. In the story above where the fire started there was one large room spanned by trusses. A gallery was hung from the floor beams, and after the fire it hung in festoons. So far as Mr. Post could ascertain, the floor beams and trusses, though protected so slightly in the lower flanges, suffered no appreciable damage. He infers from this that if the beams are thoroughly bedded in and covered by terra-cotta and mortar following any of the present forms which are in the market, it is not possible for a fire to dangerously affect the steel work. In his judgment, any of the recent and thoroughly well-constructed buildings which have been put up in New York can be called practically fire-proof, though in case of a great exterior conflagration he believes that in many buildings the skeleton construction would be sufficiently affected by unequal expansion to render the removal of the building necessary.

He believes that, on the whole, the forms of terra-cotta blockings and fire-proof shapes are satisfactory: He would not advise, however, any form which permitted of large or continuous voids in the thickness of the floor, unless such voids were blocked off at intervals by solid partitions. Other things being equal, he prefers a solid light filling between the beams.

It has been Mr. Post's practise to set the exterior columns of the steel skeleton well inside the wall of the building, separating them from the exterior construction by a waterproofing of some form and surrounding them thoroughly with cement grout and porous terra-cotta at least 4 ins. outside of the outer flanges of the steel. This is the construction which he used in the St. Paul Building, the outside walls being supported by the floor beams, which project beyond the columns and form cantilevers. He does not feel, in the light of his experience, that there is actual necessity for any terra-cotta under the flanges of the beam, though he usually specifies a thickness of 1¼ in. In the case of girders he specifies 2 ins. in thickness of terra-cotta around the flanges, which he believes is ample. For fire-proofing columns he uses nothing but terra-cotta. He does not believe that a dangerous heat would go through any of the present market constructions of terra-cotta fire-proofing if used in an intelligent and proper manner.

Mr. Francis H. Kimball, of Kimball & Thompson, New York, stated that, in his judgment, porous terra-cotta can thoroughly fire-proof all the construction of a building and is the best medium for the purpose on the market. He has used this material in the Manhattan Life Building, the Standard Oil Building, and a number of other large structures in New York. The flat arch construction, however, as ordinarily employed, is not absolutely satisfactory. It forms a good ceiling and answers the purpose of fire-proofing admirably, but the filling over the terra-cotta archings, composed of a low grade of concrete, is apt to settle and cause cracks in the finished tile floor construction. In his practise he has never used the end construction. He considers that the floor arches themselves are not called upon to really carry any load except their own weight, as in nearly every case continuous wooden sleepers are placed from beam to beam, which actually carry all of the superficial load. He uses skew-back blocks which lap under the beams 1 in., which he considers ample protection for the beam, and prefers such construction to the use of slippers. When asked as to whether the present systems of fire-proofing with terra-cotta blocks have been tested in actual use by fire and water so that we can be absolutely sure of their ultimate resistance, he said that there had been really no fires of any extent in the most recently constructed fire-proof buildings; consequently it is impossible to say that any of these structures have been submitted to extreme tests, but judging by such opportunities for observation as have arisen, it is possible to make a building absolutely fire-proof by the use of hollow terra-cotta. He instanced a test by fire of a building owned by the Potter estate, corner of 8th Street and Broadway, in which a steel column in the basement on the corner, which was covered with terra-cotta blocks and a thin layer of finished plaster, was exposed to a very intense heat from a fire in the surrounding stock of dry goods, and was subsequently, before being cooled to any degree, exposed to the action of water as well. Beyond the plaster being peeled off no damage occurred to the construction and the steel was not affected at all.

In the Manhattan Building, Mr. Kimball employed hard terra-cotta for the floor construction, but he would not be inclined to use the hard blocks again, as he preferred the porous. For fire-proofing columns his practise is to use terra-cotta with a thickness of at least 4 ins.

When asked as to the advisability of using stone outside the steel columns, he stated that he did not believe it could be relied upon to resist the flames. A statement often heard is that New York is building up so rapidly with large fire-proof buildings that it is not likely a conflagration could get started with sufficient impulse to extend very far. But right in front of the Manhattan Building, on the opposite side of Broadway, there is a large area covered with buildings with the ordinary wooden floor construction, which might,

under certain circumstances, get afire and produce a conflagration of sufficient intensity, if it should encounter a stone-faced building in its path, to entirely strip off the exterior stone facing in a few minutes, and leave the steel columns exposed to the action of the heat, with the inevitable result of the columns yielding and the whole building collapsing. He considered that for fire-proofing purposes 4 ins. of brick or terra-cotta would be better protection than a foot of stone, and that in a fire-proof floor the terra-cotta blocks ought to be bedded solidly around the beams. He suggested that instead of the concrete or cinders filling over the terra-cotta blocks, which is very customarily employed, it would be better either to have blocks made lapping under the beam, and the whole depth of the beam, or to fill in over the arch blocks with light terra-cotta. He had occasion some time since to make investigations in regard to the weight of the various fire-proof constructions, and he found that the ordinary cinders concrete would actually weigh about 90 lbs. per cubic foot, whereas terra-cotta blocks which would be amply sufficient for filling purposes need not weigh over 45 lbs. per cubic foot, a saving of 50 per cent., which in a building many stories high means a vast saving in the structural steel as well as in the foundation work. Mr. Kimball has used construction of this description and believes that it gives a floor which will not shrink nor allow the marble or tile work to crack. In the construction of the roof over Altman's store, he built up over the terra-cotta archings with porous terra-cotta blocks to obtain the necessary pitch to throw the water off. It is a very simple matter to make long filling blocks quite light, with end pieces so constructed as to lap over the top flange of the girder, setting these light blocks over the constructive arch blocks. This would give a light, absolutely fire-proof, non-shrinkable floor construction, which would be very stiff against lateral stress.

For fire-proofing about the webs and flanges of the girders Mr. Kimball advises 4 ins. of terra-cotta, and he has found it necessary to have special shapes made for this purpose. This was done in the Manhattan Building. In regard to exterior walls he has given considerable study to devising some system of construction which would be light, strong, and practically impervious to water. It is well known that a brick wall will soak water even in an ordinary storm, and a driving rain will beat through even 4 ft. of brickwork. He studied out a system employing constructive terra-cotta blocks, which he considers very adaptable for party walls above the roofs of adjoining buildings or any exterior wall where the surface can readily be got at. The visible exterior surface consists of 1 in. of Portland cement, the wall itself being built of hollow porous terra-cotta blocks laid in any thickness from 8 to 24 ins. The cement keeps out the moisture, and the blocks are light, strong, and warm, besides being absolutely fire-proof. He had a section of this construction set up for experiment and specified it for the Manhattan Building, but circumstances led to its being abandoned, though he considers it an excellent scheme. He would use such construction for party walls, gable ends, etc., and taken in connection with the steel frame it is possible to have it laid up so as to be thoroughly bonded and possess very nearly the rigidity of brick, while the weight is only about one third.

In conclusion, Mr. Kimball calls attention to the possible danger which might arise from a great conflagration even in so well built a city as New York, and stated that the system of fire-proofing by use of terra-cotta is perfectly satisfactory in theory, and can be developed in such a manner as to give the best results; but as often employed the details are very carelessly attended to, and the construction is usually not watched with sufficient care in ordinary building operations.

Mr. Bruce Price, of New York, called attention to the fact that there are many different forms of blocks for floor construction, some of them being very imperfect mechanically, and others as near perfect as could be expected of a material which has to be handled by all sorts of mechanics. He considers the end construction following the Maurer system one of the best which the market now affords, being fully 20 per cent. lighter than some of the other shapes and at least 25 per cent. stronger. As an instance of the strength of this type of floor, in the American Surety Building, erected from his plans, after the floor blocks were set in place blocks of granite weighing as high as 5 and 8 tons were dumped on the archings and worked over before being set, without the slightest damage to the construction. The weak part of the construction is the amount of protection to the flanges of the beams, which at the best is none too good, though this is a question of mechanical excellence rather than of suitability of material. He considers that in setting terra-cotta blocks only the best of Portland cement should be used. He believes terra-cotta to be an excellent material for partitions on account of its strength as well as its sound-proof qualities, while for resisting the spread of a fire the hollow blocks would undoubtedly last longer than anything else. In regard to fire-proofing on columns, when his clients and the conditions will permit, he employs terra-cotta, as he has found it perfectly satisfactory, and it answers every purpose of fire protection and solidity. Mr. Price prefers the hard-burned to the porous terra-cotta as he feels he can get the best results on ceilings and the resulting work is considerably stronger.

Mr. C. T. Wills, who was the builder of the American Surety Building as well as many other large structures in New York, said in reply to a question, that in his judgment it was a disadvantage to use porous terra-cotta for floor blocks on account of its tendency to absorb water. He considered the hard-burned terra-cotta amply sufficient protection against fire, as the heat would not go through either hard or porous to any extent. It is possible by using terra-cotta to build a structure which shall be absolutely fire-proof, and he felt that nothing else would give equal satisfaction, while as a matter of practical building construction, terra-cotta is by all odds the best material in the market.

Mr. E. A. Rogers, who was superintendent for Mr. Price on the Amercan Surety Building, stated that hollow terra-cotta blocks formed a construction for partition work which could be depended upon not to crack, warp out of plumb, or fail in being sufficiently stiff against lateral pressure. The blocks afford an excellent opportunity for passage of wires, pipes, etc., and will not heat through in case of a local fire in a single room. With the hard terra-cotta floor blocks which were used in the Surety Building there was no trouble whatever from moisture. For furring against outside walls nothing is more satisfactory than hollow terra-cotta blocks, and for fire-proofing against columns the best practise is to use from 2 to 4 ins. of terra-cotta. He had found the hard terra-cotta blocks hard to cut and easily broken, and would under some circumstances prefer the porous terra-cotta, though he did not consider them so strong as the hard. For protecting the lower flange of the beams, he considered that a slipper 1 in. thick was less apt to give trouble than the forms in which the springing block was molded to fit under the flange of the beam.

A Boston architect who has been identified with some of the largest buildings throughout the country, but who prefers not to have his name appear, was quite emphatic in the expression of his opinion in regard to the absolute merits of terra-cotta as a fire-proofing medium, which, in his judgment, amply meets all requirements and can be fully depended upon to resist the action of both fire and water. This architect, in his practise, makes it a custom to use for floor arches terra-cotta blocks which are the full depth of the beams. If a 10 in. beam is used a 10 in. block is specified, and if a 15 in. beam is required a block is made of corresponding depth lapping 1 in. under the flange of the beam, thus leaving 1 in. above the blocks below the tops of the beams, which space is filled in solid with cement concrete. If a wooden flooring is to be used, a 2 in. underfloor is then dogged directly to the iron beams, above which is laid the finished floor. In this way the steel work is thoroughly protected on the sides and the bottom flange, and he believes that no fire would ever work through 3 ins. of solid wood to get at the upper flange of the beam.

Other interviews will be reported in the February number.—ED.

Mortar and Concrete.

AMERICAN CEMENT.

BY URIAH CUMMINGS.

CHAPTER VII.

CEMENT TESTING.

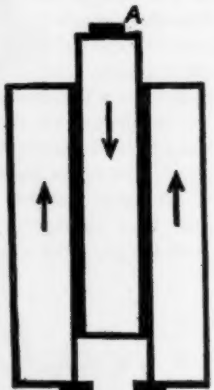
(*Continuation of tests made by Prof. Cecil B. Smith.*)

SERIES IV.

SHEARING TESTS.

THIS series of experiments was carried out with a view of obtaining more information on the shearing strength of mortar. The method adopted was as follows:—

Three bricks placed as shown in sketch were cemented together, and tested at the end of one month. It was found that by placing pieces of soft wood at *A*, *A*, *A*, an action as nearly as possible a shear was obtained, and gave very satisfactory results, the pressure being practically concentrated along the two mortar joints. No side pressure was applied, because the desire was to obtain minimum results where friction was not assisting.



The combined effect of adhesion and friction can easily be computed if the adhesion and superimposed load are known.

The results are divided into lime-mortar, natural cement mortar, and Portland cement mortar, also into ¼ in. and ½ in. joints, also into flat common unkeyed bricks and pressed Laprairie brick keyed on one side. (1) The lime mortar was mixed 1 lime to 3 of standard quartz sand, by weight; (2) natural cement mortar was mixed, 1 of No. 2 natural cement to 1½ standard sand; (3) Portland cement mortar was mixed, 1 of No. 5 Portland cement to 3 standard sand. (See exhibits of bricks with mortar attached.) The test pieces were chiefly allowed to stand in the laboratory at a temperature of 55 to 65 degs. Fahr., but one set of natural cement mortar and two of Portland cement mortar were duplicated by immersing in water for 29 days, after setting in air 24 hours before submersion.

These results point out many interesting facts: (*a*) the first fact noticeable is that the results are independent of the *thickness* of joint; this is true of lime and cement mortars. (*b*) The next one is not evidenced to any extent in the table, but was quite apparent in the testing, viz., that the adhesion of the mortar to the brick was greatest when the mortar was put on very soft, and least when the mortar was dry. This will largely uphold the use of soft mortars by masons, albeit their reason is a purely selfish one, the mortar being easy to handle. The tensile tests of cements made *very* soft are lower than when the mixture has the minimum amount of water for standard consistency. But for adhesive tests the case is evidently the reverse. It may be here mentioned that in these tests all bricks were thoroughly soaked with water before the joints were laid. (*c*) Coming now to the tests on lime mortar, the shears were through the mortar, except in the fourth experiment, and therefore they are quite independent of the key of the pressed brick on the surface of adhesion. This would point out the fact that keyed brick are superfluous in lime mortar joints, and the shearing strength per square inch averages about 10½ lbs. per square inch. The tensile strength of the same mixture at the same age was 30 lbs. per square inch, and the compressive strength 102 lbs. per square inch. (*d*) The natural cement mortar showed distinctly that its adhesive strength was not as great as its shearing strength, which is the reverse of the lime mortar tests. It also showed that the keyed brick aided in some unknown way, for the results on them are three times as great as with the common flat brick. Of course this may have been, and probably was, partly due to the different surface of adhesion. In five tests out of twenty-one made on the natural cement mortar, the mortar sheared through, and the average of these five was 97 lbs. per square inch, which gives the shearing strength proper, while the average adhesive strength of the thirteen tests in air which came loose from the bricks was 26 lbs. per square inch in common brick, 48 lbs. per square inch on Laprairie pressed brick, and 38 lbs. per square inch on Laprairie pressed brick for three tests submerged in water for the whole period.

This would show that the adhesive strength is nearly twice as great on pressed brick as common brick, and that submersion in water had a rather harmful effect than otherwise on the adhesive strength, and was certainly of no benefit.

The tensile strength of the same mortar at the same age was 132 lbs. per square inch; the compressive strength was not obtained, but would have been about 1,000 lbs. per square inch. The hints to be taken from these tests are that pressed brick keyed on both sides will give much higher results than flat common bricks, and would probably place the shearing strength of such joints at 100 lbs. per square inch, and make it largely independent of the consistency of the mortar. Also that the shearing strength is very much higher in proportion to the tensile strength than was the lime mortar shearing strength to its tensile strength, but about the same proportion to its compressive strength, *i. e.*, 10 to 1.

It becoming evident that the thickness of joint had no appreciable effect, the Portland cement mortar tests were made all ¼ in. thick.

TABLE VI.

TABLE OF SHEARING TESTS, OR MORTAR ADHESION TO BRICK SURFACES (in shear.)

Series IV.

Kind of Mortar.		Joint.	Brick.	No. of tests.	How indurated.	Shear in lbs. per square inch. Average.	Least.	Greatest.	REMARKS.
Lime 1.	Sand 3.	¼"	A	5	in air.	9.7	8.4	11.9	All sheared through the mortar.
Lime 1.	Sand 3.	½"	A	4	in air.	12.1	6.1	19.8	All sheared through the mortar.
Lime 1.	Sand 3.	¼"	B	5	in air.	12.0	9.1	15.5	All sheared through the mortar.
Lime 1.	Sand 3.	½"	B	5	in air.	8.0	5.5	11.0	All came away from brick (mortar dry).
No. 2. Natural Cement	1 Sand 1½.	¼"	A	5	in air.	22.3	8.0	32.1	All came away from brick.
Natural Cement	1 Sand 1½.	½"	A	5	in air.	29.0	24.0	33.0	All came away from brick.
Natural Cement	1 Sand 1½.	¼"	B	5	in air.	75.0	25.0	118.0	Two came away from brick, three sheared.
Natural Cement	1 Sand 1½.	½"	B	3	in air.	85.0	43.0	118.0	One came away from brick, two sheared.
Natural Cement	1 Sand 1½.	½"	B	3	in water.	38.0	34.0	42.0	All came away from brick.
No. 5. Portland Cement	1 Sand 3.	¼"	A	3	in air.	10.6	10.2	11.6	All came away from brick. } The brick which was on top in the original laying, always sheared first and at a less load than that of lower one, which, of course, set under twice as much load or pressure.
Portland Cement	1 Sand 3.	¼"	A	3	in water.	13.0	10.2	16.4	All came away from brick.
Portland Cement	1 Sand 3.	¼"	B	3	in air.	16.5	9.2	24.2	All came away from brick.
Portland Cement	1 Sand 3.	¼"	B	3	in water.	27.1	20.2	36.9	All came away from brick.

A. Common, flat, unkeyed, salmon brick.
B. Láprairie pressed brick, key on one side.

The results are surprisingly low. The adhesion on the common brick is about the same for air drying or submersion in water, and is slightly less than one half that of natural cement mortar tests of 1½ to 1. This is a significant fact, for while a neat tensile test of No. 2 natural cement 4 weeks old is 268 lbs., the No. 5 Portland is 459 lbs. for the same age, and a 3 to 1 No. 5 Portland is 82 lbs. for same age. (See table of general laboratory results.) Thus while any test of this cement would show that a 3 to 1 mixture of the latter would be nearly equal to a 1½ to 1 test on the former, yet in their adhesive properties to common brick the heavily dosed sand mixture was only half as strong as the natural cement mortar with a smaller dose of sand. We might easily have expected this; but the main point is: is it taken account of, in considering the comparative values of these mixtures, that the adhesive strength of a Portland cement mortar heavily dosed with sand is low as compared with a weaker but richer mixture of natural cement mortar? The shearing of Portland mortar shows that the adhesion to pressed brick is greater than to common brick, but not in such proportion as in natural cements, being 1½ or 2 to 1 in place of 3 to 1 in the latter. But here again comes out the advantage given to Portland cements by testing them under water; the submerged specimens are stronger than open air ones, while in natural cements the reverse is the case.

Table VI. summarizes the results obtained.

SERIES IV. (*A*)

THE STRENGTH OF MORTAR IN COMPRESSION IN BRICK MASONRY.

All engineers realize that the strength of mortar is much less tested in cubes than in thin layers, but just what proportion they bear to one another is not very well known. The following experiments have been made with a view of obtaining this information. (See table VII.)

At the same time that these tests were made, mortar was also made into test pieces, and tested at the same age. We are thus enabled to form an idea of the relative strengths of mortar in thin joints and in cubes, and also to form an intelligent opinion of the comparative strengths of lime mortar, natural cement mortar, and Portland cement mortar. The mortars of the fourth, fifth, and sixth tests are identical with the mortars of the *shearing* tests, and show the same clear superiority of the natural cement 1½ to 1 over the Portland cement 3 to 1 when used in this manner. Table VIII., summarizes the results obtained.

Roughly speaking, the lime mortar at 1 week 5 to 1 is 6 times as strong; the lime mortar at 1 week 3 to 1 is 14 times as strong; the natural cement mortar at 1 week 1½ to 1 is 4 times as strong; the Portland cement mortar at 1 week 3 to 1 is twice as strong, as the same mortar tested in cubes, at the same age.

Referring to the amount of compression in Table VII., it will be seen that the amount of compression per foot is much less according as this ratio is less; *i. e.*, the less yielding the mortar, the nearer does the strength in cubes approach to the strength in joints. This is to be expected, because the more yielding substances will be at a much greater disadvantage when unsupported at the sides than if enclosed in a thin masonry joint.

In the second, third, fourth, and sixth tests at 17,500 lbs., the load was released, and the permanent set observed was as given in the fifth column of the preceding table.

It seems probable from this, therefore, that the lime mortars must have yielded to an injurious extent before there were any external signs. But whether this was the case or not, it is impossible

TABLE VII.

MORTAR JOINTS IN COMMON BUILDING BRICK PIERS.

Composition of Mortar.	Age of Test.	Thickness of Joints.	Dimensions of Brick Pier.	Per cent. water in mortar.	Loads in lbs. per square inch. 1st signs of failure in mortar.	1st signs of failure in brick.	Bricks failing rapidly.	Maximum load.	Compression per foot under a total load of 5,000	20,000	35,000
No. 1. 1 Lime. 5 Building sand.	1 week.	3/16"	7.80" by 7.85". 16.57" high. 6 bricks. 61.2 sq. in. area.	37 (?)	245	327	980	1,143	.015"	.08"	.13"
No. 2. 1 Lime. 5 Building sand.	3 weeks.	3/16"	8.0" by 8.0". 11.16" high. 4 bricks. 64.0 sq. ins.	37	469	563	1,406	1,553	.007"	.043"	.075"
No. 3. 1 Lime. 5 Building sand.	3 weeks.	3/16"	7.9" by 7.9". 24.50" high. 9 bricks. 62.4 sq. ins.	37	400	689	897	1,282	.005"	.053"	.094"
No. 4. 1 Lime. 3 Laboratory sand.	1 week.	¼"	7.75" by 7.85". 11.42" high. 4 bricks. 60.84 sq. ins.	34	287	575	....	1,117	.032"	.133"	.158"
No. 5. 1 of No. 2 Natural cement. 1½ Lab'tory sand.	1 week.	¼"	7.80" by 7.90". 11.15" high. 4 bricks. 62.01 sq. ins.	22½	968	1,190	1,403	1,984	.009"	.027"	.054"
No. 6. 1 of No. 5 Portland cement. 3 Laboratory sand.	1 week.	¼"	800" by 7.95". 11.30" high. 4 bricks. 63.60 sq. ins. area.	20	755	959	1,305	1,364	.007"	.007"	.019"
No. 7. 1 No. 5 Portland. 1½ Lab'tory sand. Common building bricks.	1 week.	¼"	8.00" by 8.00". 11.5" high. 4 bricks. 64.0 sq. ins. area.	20	1,125	1,563	....	1,734	.000"	.0045"	.011"
No. 8. 1 No. 11 Portland. 1 Lab'tory sand. Laprairie pressed brick.	12 days.	¼"	8.3" by 8.3". 11.8" high. 4 bricks. 68.9 sq. ins. area.	....	1,679	1,800	1,930	1,960	.001"	.006"	.011"
No. 9. 1 Lime. 3 Lab'tory sand. Laprairie pressed brick.	4 weeks.	¼"	8.2" by 8.2". 11.5" high. 4 bricks. 67.2 sq. ins. area.	35	260	853	....	1,263	.048"	.115"	.156"
No. 10. 1 No. 2 Natural. 1½ Lab'tory sand. Laprairie pressed brick.	4 weeks.	¼"	8.4" by 8.4". 11.0" high. 4 bricks. 70.6 sq. ins. area.	22½	1,345	1,629	1,746	1,983	.000"	.0027"	.005"
No. 11. 1 No. 5 Portland. 3 Lab'tory sand. Laprairie pressed brick.	4 weeks.	¼"	8.4" by 8.4". 11.1" high. 4 bricks. 70.6 sq. ins. area.	20	1,204	1,600	1,629	1,785	.002"	.011"	.016"

NOTE:—These results were obtained after the publication of the paper, and are the additional pier tests promised in the text.

to say, because the compression was quite uniform up to and in many cases much past the points of evident failure.

TABLE VIII.

	Strength of Mortar per square inch.			Loads released at 17,500 lbs., set observed per lineal foot.	
	In joints.	In cubes.	In tens'n.		
(1)	245	40	17	....	1 week old, mortar, 1 lime, 5 sand.
(2)	469	57	20	.01"	3 weeks old, mortar, 1 lime, 5 sand.
(3)	400	57	20	.03"	3 weeks old, mortar, 1 lime, 5 sand.
(4)	287	21	....	.08"	1 week old, mortar, 1 lime, 3 sand.
(5)	968	250	....	....	1 week old, mortar, 1 Natural Cement, 1½ sand.
(6)	755	341	43	.00	1 week old, mortar, 1 Portland Cement, 3 sand.

It seems fair to suppose that 1 week and 3 weeks are about the minimum and average times which would elapse before the maximum load might be put on a brick wall, and when it is remembered that

these joints were less than ¼ in. thick, the amount of compression in a high brick wall under a load of 80 or 90 lbs. per square inch is seen to be very great, and under a load of 300 to 400 lbs. per square inch, a brick wall 50 ft. high in lime mortar would not only fail, but compress from 2 to 6 ins. in doing so — the compression practically all taking place in the mortar, as in the unyielding Portland cement mortar the compression is seen to be very small.

The second part of this paper will contain tests made on piers built with pressed brick, in which the mortar has had longer time to harden, and interesting results are looked for.

The brick in this case was, as mentioned in Table VII., common building brick. The photograph given illustrates the method of testing and the interesting manner of failure of fifth test, in which the lines of least resistance are clearly defined.

(To be continued.)

An architectural contemporary announces that a fair porportion of iron in a mortar makes no difference in regard to the durability of the latter. Within certain limits that is perfectly true; but the investigator might have added that durability is not everything. Bricks are frequently blamed for being "streaky," and it would be found in most cases that this appearance is due to the iron in the mortar. The sand used commonly contains minute grains of iron in a condition to be readily oxidized, unless closely imprisoned within the mortar. On weathering, these may not impair the durability of the cementing material as a whole, but they induce disfigurement on the surface of the brick.— *Exchange.*

LIME, HYDRAULIC CEMENT, MORTAR, AND CONCRETE. I.

BY CLIFFORD RICHARDSON.

The Foundation of Cements. The foundation of all cements, except those of a bituminous nature, which are used for binding together materials in masonry and concrete, is lime, the oxide of the metal calcium, which, although never found in the free state, is, in its various combinations, so widely diffused in nature.

Occurrence. It occurs as carbonate in marble, in limestone, in chalk, in marl, and in shells, as sulphate in gypsum, as silicate in many minerals and rocks, and as phosphate in a few.

Forms of Importance. Carbonate of lime in its purer forms and, when mixed with clay, in argillaceous or hydraulic limestones and some concretions, is of the greatest importance to the engineer and builder. From those forms in which there is but a small admixture of other substances lime is made. From those which contain clay or from a mixture of the pure carbonate with clay, hydraulic lime and cement are made.

CAUSTIC OR QUICKLIME.

The product of the expulsion of carbonic acid from the purer forms of carbonate of lime at a red heat is caustic or quicklime. It is the more or less pure oxide of the metal calcium, of which it contains about 95 per cent. when of the best quality.

The process of making lime in this way is called lime burning. It is conducted in kilns of various forms in which a suitable temperature can be maintained.

Lime Kilns. The kilns in use in lime burning are of both the intermittent and continuous types, and these again may each be divided into two classes, one in which the fuel is mixed with the limestone, the other where the combustion is carried on in a separate chamber or furnace, apart from the stone.

Whatever the method of burning, the product is much the same, the advantage of one form over another being purely one of economy of fuel and completeness and regularity of burning. In the United States almost all the lime burning is done in kilns of the continuous type, with the fuel, either coal or wood, mixed with the stone. Wood is supposed to produce a better lime, as the ash is smaller in amount and not so silicious. Where fuel oil, or gas is available, one of these sources of heat is the most satisfactory for lime burning.

Lime Burning. Lime burning consists of raising limestone to that temperature at which it will lose its carbonic acid. It is usually carried on at a bright-red heat or about 1,700 degs. Fahr., although carbonate of lime begins to decompose at a lower temperature. Too high a temperature is undesirable, as this may produce a chemical combination between the lime and the impurities which all limestones contain to a greater or less degree. If these impurities are silicious, silicates of lime are formed which fuse and prevent the lime from slaking properly. The formation of such silicates may also take place with the ash of coal. This is known as clinker and is carefully thrown out in drawing the lime from the kiln. Smaller particles, however, cannot be separated and injure the quality of the lime.

It is necessary that a current of air should pass through the kiln, when lime is burned, to carry off the carbonic acid, as carbonate of lime, when heated in a vessel from which the gas cannot escape, is not decomposed and no lime is formed. A current of steam is even more desirable than air, but this is never used in practise, as it is hardly economical. The limestone is, however, often sprinkled with water which has, to a small degree, the same effect.

SOURCES OF LIME.

Limestone and marble are the usual sources of lime, but it can also be made from chalk, some marls, and oyster shells. Chalk is not found in this country, marl is used only for Portland cement, and

oyster-shell lime principally for fertilizers and purifying gas. Stone lime is preferable for building purposes to any of the other forms.

CHANGES IN LIMESTONE IN BURNING.

The changes which a limestone undergoes in burning are loss of weight by the removal of carbonic acid, water, and organic matter if present; change of volume, of density, of color, and of hardness.

Massive limestones, or marbles such as are used in making lime, have a specific gravity and density of from 2.65 to 2.75. Lime in the form of the stone from which it is made, that is, in lumps, is porous owing to the loss of carbonic acid and water. It has, therefore, a density of only 1.5 to 1.85, although the specific gravity of the lime is usually about 2.8 to 3.1, and that of the pure oxide 3.16.

The color of many limestones is due to organic matter which burns away and leaves the caustic lime white. If it does not burn away it is due to mineral impurities which are undesirable.

The hardness of lime is of course inferior to that of the stone from which it is made owing to the porous condition in which it is left, and there is a slight increase in volume due to the expansion of the gas in the stone.

From pure carbonate of lime exactly 56 per cent. of oxide or caustic lime should be obtained, but owing to the loss of water and organic matter, as well as carbonic acid and to waste, this figure is never reached except when there are admixtures of clay or silica. Then the loss of carbonic acid is not as great as from pure carbonate of lime. When the limestone contains much carbonate of magnesia the product of burnt lime may be considerably reduced, as this carbonate contains more carbonic acid than carbonate of lime. Such a limestone is known as dolomite and is of inferior value for making lime.

COMPOSITION OF LIMESTONE.

The ordinary marbles and limestones available for burning are never entirely pure. They contain a greater or less admixture of carbonates of magnesia and iron, of clay, and other silicates, of silica, of alkalies, of organic matter, and of sulphates, phosphates, and pyrites.

The following analyses are typical of the variations found in their composition.

ANALYSES OF LIMESTONE.	Carbonate of Lime.	Carbonate of Magnesia.	Iron and Aluminum.	Silica and Silicates
No. 1 White Marble, Maryland,	97.2	1.0	.6	1.0
No. 2 Blue Limestone, Maryland,	96.0	.5	1.9	1.8
No. 3 Silicious Marble, Maryland,	81.8	.8	.9	17.2
No. 4 Dolomite Tompkins Cove, N. Y.	53.8	41.2	.7	2.6
No. 5 Hydraulic Limestone, Maryland	57.9	3.0	4.9	20.4

EFFECT OF IMPURITIES. We find limestones which are nearly pure, having 97.2 per cent. of carbonate of lime, in the form of white marble, and 96.0 per cent. in a blue limestone. In contrast are stones which contain silica or clay as well as silica, as shown by the presence of iron and aluminum, and those which are mixed with carbonate of magnesia. All the forms have their peculiar properties. The purest should be, of course, selected for lime burning. The impurities in a limestone have an important influence on the character of the caustic lime made from it. A quicklime prepared from a limestone comparatively free from impurities and consequently nearly pure calcium oxide is called a rich or fat lime. With the increase of admixture of other substances the lime becomes poor, that is to say, it does not slake easily, and when this exceeds 10 per cent. the burnt stone begins to slake with more difficulty or fails to do so at all, and can be no longer regarded as a mere lime, but is hydraulic or magnesian lime depending upon whether the admixture is clay or carbonate of magnesia. Already with from 5 to 8 per cent. of clay in the limestone, the lime has hydraulic properties, and these increase until it is very highly hydraulic with 25 per cent.

When the admixture is magnesian and the rock is composed of carbonate of lime and magnesia, without clay, the resulting lime does not attain hydraulic properties, but merely becomes poor and fails to slake readily. With even 10 per cent. of magnesia, lime becomes poor, and with a larger amount still more unsatisfactory. Lime from dolomite, or magnesian limestone, which is very common in the United States, contains about 21 per cent. of magnesia, and is of inferior value for building purposes. Too much of this lime is used in the country, and it should be avoided as far as possible under all circumstanees.

Lime containing a large amount of magnesia, if free from im-

Requirements for American Portland for coast Fortifications, U. S. Government.	Fineness through No. 50 sieve.	Fineness through No. 100 sieve.	Fineness through No. 200 sieve.	Tensile strength 1 in. Briquettes, neat, 24 hours in air.	Tensile strength 1 in. Briquettes, neat, 24 hours in air, and 6 days in water.	Tensile strength 1 in. Briquettes, neat, 24 hours in air, and 27 days in water.	Tensile strength 1 in. Briquettes, 1 cement, 2 sand, 24 hours in air, 6 days in water.	Tensile strength 1 in. Briquettes, 1 cement, 2 sand, 24 hours in air, 27 days in water.	Tensile strength 1 in. Briquettes, 1 cement, 3 sand, 24 hours in air, 6 days in water.	Tensile strength 1 in. Briquettes, 1 cement, 3 sand, 24 hours in air, 27 days in water.	Hot water tests.
At mouth of Cape Fear River, N. C.	99%	90%	70%		500 lbs.	600 lbs.	175 lbs.	250 lbs.			Briquettes 24 hours in air, 24 hours in water 212° F.
At Sandy Hook, N. J.				250 lbs.	450 lbs.				125 lbs.	200 lbs.	
Tybee Island, Ga.	100%	90%							125 lbs.	200 lbs.	Pats 24 hours in air, 3 hours in water 212° F.
Sullivan Island, S. C.		85%		200 lbs.	375 lbs.	500 lbs.			125 lbs.	175 lbs.	
Sheridan's Point, Va.	95%			175 lbs.	375 lbs.						After 24 hours, immersion in water 212° F.
Galveston, Texas.	95%			75 lbs.	300 lbs.	400 lbs.					
Gull Island, N. Y.	95%			75 lbs.		400 lbs.					
Key West, Fla.	96%	90%	70%	125 lbs.	400 lbs.	500 lbs.	150 lbs.	200 lbs.			Briquettes 24 hours in air, and 24 hours in water 212° F.
Dutch Island, R. I.	95%	77%		250 lbs.	400 lbs.	600 lbs.			125 lbs.	200 lbs.	
San Diego, Cal.				200 lbs.	450 lbs.	700 lbs.					
Portland, Me.	95%			150 lbs.	380 lbs.						
Portsmouth, N. H.	95%			175 lbs.	400 lbs.						

purities, may be used, however, for furnace linings as it resists heat well and is very basic, not fusing as readily as pure lime in presence of silica.

COMPOSITION OF CAUSTIC LIME.

The composition of commercial quicklime is varied, depending on the kind of rock from which it is made. The following are analyses of some typical limes, found in our markets: —

ANALYSES OF CAUSTIC LIME.

No.	Source.	Lime.	Magnesia.	Iron oxide and alumina.	Silica and silicates.	Loss on ignition.
1	New York from limestone	95.6	.6	.8	1.2	1.0
2	Baltimore Co. from marble	95.3	.8	.9	2.2	.7
3	Washington, D. C. from dolomite	73.3	21.4	4.0	.9	1.3
4	Connecticut from limestone	85.1	5.7		2.8	6.3
5	Connecticut from dolomite	55.3	36.4	3.2	1.4	3.7
6	West Virginia from limestone	89.9	2.2	5.8		2.2
7	West Virginia from limestone	74.2	2.4	1.5	3.9	17.9

It appears that limes which are 95 to 96 per cent. pure are the best that are attainable commercially and that they are frequently less pure. When fresh from the kiln lime would, of course, show no loss on ignition, but on storage it absorbs water with great avidity from the air until, as in that numbered seven, it has reached 17 per cent., when it is nearly half air slaked. Fresh lime, or that which has been carefully protected from the air, is of much greater value for building purposes, although too often this is unattainable.

UNIFORMITY IN CEMENT SPECIFICATIONS.

UNDER a clause in the bill making appropriations for the construction of gun implacements and fortifications, which passed Congress June 6, 1896, the cement used is required to be of domestic manufacture. The specifications of the various officers of the corps of engineers in charge of this work, as far as they relate to Portland cement, have been brought to our attention and are given in abstract in the table on opposite page.

As there has been considerable discussion recently in the journals of the engineering and allied professions in regard to uniformity in specifications for Portland cement, the very considerable variations in the above requirements is noticeable, especially as the work is all of one kind and to be done entirely by one organized body of men, who are supposed to represent the very highest standard in their profession. They are, nevertheless, not agreed as to what the requirements of a first-class American Portland cement should be or at least how its quality should be determined.

One requires a neat test of 75 lbs. in one day in air, another one of 250 lbs. under the same circumstances. The variations in the requirements for a neat test at the age of seven days are relatively less, lying between 300 and 500 lbs., but even these are large. At twenty-eight days the demand is for a very varying increase of strength over that at seven days, from 100 to 250 lbs. Two of the engineers require a test with two parts of sand, four a test with three parts, and six no sand test. As this is, perhaps, the most reliable test of Portland cement, it is remarkable that it should be omitted by half of those in charge of such improvements. Four officers require the boiling test, in three cases substituting it for a sand test.

It seems unfortunate, even if the large body of engineers of this country cannot agree upon specifications for hydraulic cement, that the Corps of Engineers of the United States Army cannot set a better example than appears in their recent specifications. It should be added, however, that the manufacturers of American Portland cement should, with the use of ordinary care, be able to meet the most severe of these requirements, and that some of them are too lenient.

The Masons' Department.

THE ARCHITECT AND CONTRACTOR — IN GENERAL.

BY THOMAS A. FOX.

(*Continued.*)

WHILE it is a comparatively simple matter to lay down the general principles which should govern the relations and dealings between the owner, architect, and contractor, the most valuable rules and suggestions, after all, come only with experience. In the case of extras, for example, the results of laxity of method and delay of settlement are so trying that one severe experience is usually sufficient to prevent a reoccurrence of such difficulties. It is hardly necessary to call attention to the fact that, as the settlement for extra work or work omitted is necessarily made at the close of a building operation, it is greatly to the advantage of the architect and contractor to be in a position to close the transaction without friction or disagreement with the owner, whose most lasting impressions of a given piece of work are generally those associated with the final dealings. When differences arise during the progress of construction, the architect or contractor, if they are right, usually have the opportunity to prove their case from subsequent developments; or if there is an honest disagreement, the architect or contractor, as the case may be, can show that, although his judgment may have been at fault, his intentions were of the best, and under such conditions the offense is usually forgiven or forgotten; but let there be a serious breach at the close of a building operation, and it is almost impossible to convince an owner that he is being fairly treated, and it is quite improbable that he would, under these conditions, give the architect or builder an unqualified indorsement to enable either of them to get future work.

Early in this consideration of the relations between architect and contractor, attention was called to the fact that the ability to carry out a large building project successfully depended more on the individuals than on any hard and fast rules which can be formulated, and that a thorough knowledge of the rights of the contractor as well as those of owner should be understood and recognized by the architect. Much of the trouble between the architect and his client arises from the fact that the latter usually assumes, unless he is told to the contrary, that it is the duty of the architect to always take sides with the owner in any controversy as against the contractor. This idea, which is more common than one would suppose, and is even held by some of the narrow-minded members of the profession itself, doubtless arises from the fact that as the architect is paid by the client, he considers that he has retained a professional adviser, under practically the same conditions as he would retain a lawyer to defend a case in court. This, however, is not the position in which a conscientious member of the profession should allow himself to be placed, and before undertaking a commission from a client who has not had experience, this relationship is a matter which should be fully explained and understood. Probably, if the truth was told, the architect who claims that he holds the autocratic position of counsel for the owner would be forced to admit that such an attitude was necessary for his own protection, for the same reason that a certain architect was fond of asserting that no client employed by him ever had to pay for an extra, the simple fact being that this architect never approved such an item on a bill, although the plans and specifications coming from his office were at least no better than those from many others who made no pretense to such infallibility. This architect, judging from the highest standard of professional practise was no more just than one who went to the other extreme, and accepted commissions from the contractor, which of course in the end are paid by the owner. It has already been stated here that the responsibility for the abuses which lead to the most serious controversies in connection with building operations are about equally divided between the different parties concerned; but naturally the architect, while trying to

assume an impartial position in the matter, but at the same time anxious to raise the standard of professional practise, may give a stronger emphasis to the shortcomings of his associates than to others equally responsible. But it must be admitted that the greatest responsibility in the effort to reform the abuses, to which attention has been called in these papers, must, from the nature of things, rest upon the architect, and if he can acquire a reputation for possessing a thorough knowledge of the various requirements of his profession, and at the same time that of dealing honorably and justly with his client on the one hand and the contractor on the other, he will soon find himself in a position where he need employ only those in whom he has strict confidence, and will seldom, if ever, be forced by his client into accepting any one to perform work who will not of his own volition carry out the proposed work according to the terms of the agreement. A prominent lawyer once defined a contract as an agreement between two honest men. The bitter competition which has been found of late years among all professions and trades has naturally tended to lower the standard of business integrity; but in spite of this, and probably to the end of time, no matter what may be the position of the employer, in a vast majority of cases he prefers to hire to perform his work only those whom he is sure will live up to the terms of an agreement; and although success may come more rapidly in some instances to those who are willing to take undue advantage of their fellow men, it will not, in the long run, be as satisfactory, as substantial, or as great, as to those whose word is as good as their bond.

(*To be continued.*)

INQUIRY AND REPLY.

SHOULD lime be used in mortar to prevent freezing?

H. S. M., Kansas City.

No. On the contrary, lime delays setting, and is of no advantage.

Is the subject of a better grade of mortar, or a more liberal use of cement in masonry construction, being given due attention by architects and builders? or is the strength of bonding of secondary importance?

R. H. Meyers, St. Louis.

The arguments which are of force in this case are the same as those for the use of high-grade materials of all descriptions which are to be used in any structural work. The entire structure cannot be stronger than its weakest part, so that poor cement and mortar make any superiority of quality of other materials of no value.

FROM OTHER COLUMNS.

OLD brick are being used instead of sand to make lime mortar, in the rebuilding of the new Union Station in Columbus, O. The refuse brick from the old walls are ground in a crusher. It is said that a quality of mortar for color work superior to that obtained with sand is produced.— *Eng. News.*

COST OF HAND AND MACHINE-MIXED CONCRETE. Machine-mixed concrete can be done at from one fourth to one third of the cost of hand mixing; at the same time the machine mixing is more thorough and economical. With a given amount of aggregate, from 10 to 20 per cent. less cement can be used without impairing the strength of the finished work.

The absolutely uniform results obtained by the best grade of machine mixers lessens the danger of cracks due to uneven setting, as the expansion and contraction of the mass will vary directly as the proportion of the cement varies throughout the mass.

Therefore there is not only a direct saving in the quantity of cement used, but also in the quality of the work as well as in the finish and lasting properties.

A new cement will contract and expand more than an old and stored cement.— *Cement.*

Recent Brick and Terra-Cotta Work in American Cities, and Manufacturers' Department.

CHICAGO. — No one expects extensive building operations this year, and yet architects and builders look for a fairly good business, notwithstanding the serious disturbances caused by election events, and more recently, the failure of some large banking institutions.

The list of projects announced looks well, although there is little of special importance.

Of the building that is to be done, architects are evidently desirous of having it done on a right basis.

Hopes often expressed in these columns in the past are being realized to the extent, at least, of a preliminary organization of architects, which has been lately effected. An Architects' Business Association has been formed, which aims to protect building interests against dishonest contractors, and the profession itself against unworthy members. It is earnestly to be hoped that an effective effort will be made to obtain legislation, giving the profession a legal status.

A local daily recently created quite a sensation by announcing in bold headlines, "It's a Leaning Tower," "Masonic Temple out of Plumb," etc. Having employed a surveyor to do some investigating,

TERRA-COTTA CAPITAL, BOWLING GREEN OFFICE BUILDING, NEW YORK CITY.
W. & G. A. Audsley, Architects.
Made by Conkling-Armstrong Terra-Cotta Company.

alarm was allayed by another headline in much smaller type, "It is Perfectly Secure, and no Importance is Attached to this Singular Deviation."

The Masonic Temple is a twenty-story building, about 170 ft. square, and the north wall, at a point 265 ft. above the ground, is 9 ins. out of the vertical. It is to be hoped that other buildings are in no more immediate danger than the Temple, but the unequal settlement of this important structure will serve as a text for discussion on "rigid joints," "the danger of cast-iron connections," etc.

In the list of buildings projected, Warren H. Milner, county architect, is planning various additions to the public hospitals, jail, and infirmary.

Perkins & Krause have two factory buildings, one 75 by 100 ft., seven stories, and the other, 50 by 100 ft., five stories high.

Cowles & Ohrenstein have in hand a store building 76 by 86 ft., four stories, and a warehouse.

An apartment building, designed by Mr. Fritz Foltz, is men-

tioned in which each suite has its bedrooms in the story above its parlor, kitchen, etc.

Some three hundred million common bricks were manufactured in and about Chicago during 1896. This is only one third of the capacity of our kilns, and but two thirds the production of the previous year. This fact in itself is significant as showing the condition of the building business during the year.

ST. LOUIS.— The new year has brought little of special interest in the building line. In fact, there is more or less disappointment among the architects and builders, as it was felt that by this time there would be considerable more work under way.

Capital seems very nervous, and as soon as one excuse has become worn another is found. There have been very few business failures in our city within the last year, and no banks, but the failures throughout the country have been a disturbing element in money circles and have caused the delay of some important building schemes, but as the year advances a steady improvement is noticeable.

There has been no time within the last several years when building could be done so cheaply as now. This presents an opportunity which is being taken advantage of by many, in building good residences in the more aristocratic neighborhoods, such as Westmoreland, Portland, and Bell Places, while the business depression has tended to diminish the number of cheap flats and building of houses for speculation.

Among the handsome residences just being completed is the Dozier residence in Westmoreland Place, by Architect F. L. Wees. The building is three story and basement, of brick and terra-cotta, in the French Renaissance, and will cost $75,000.

Architect W. A. Swasey is building another near by of white brick and terra-cotta, while further up the street he has just finished a large stone residence for Mr. B. Nugent, at a cost of $65,000.

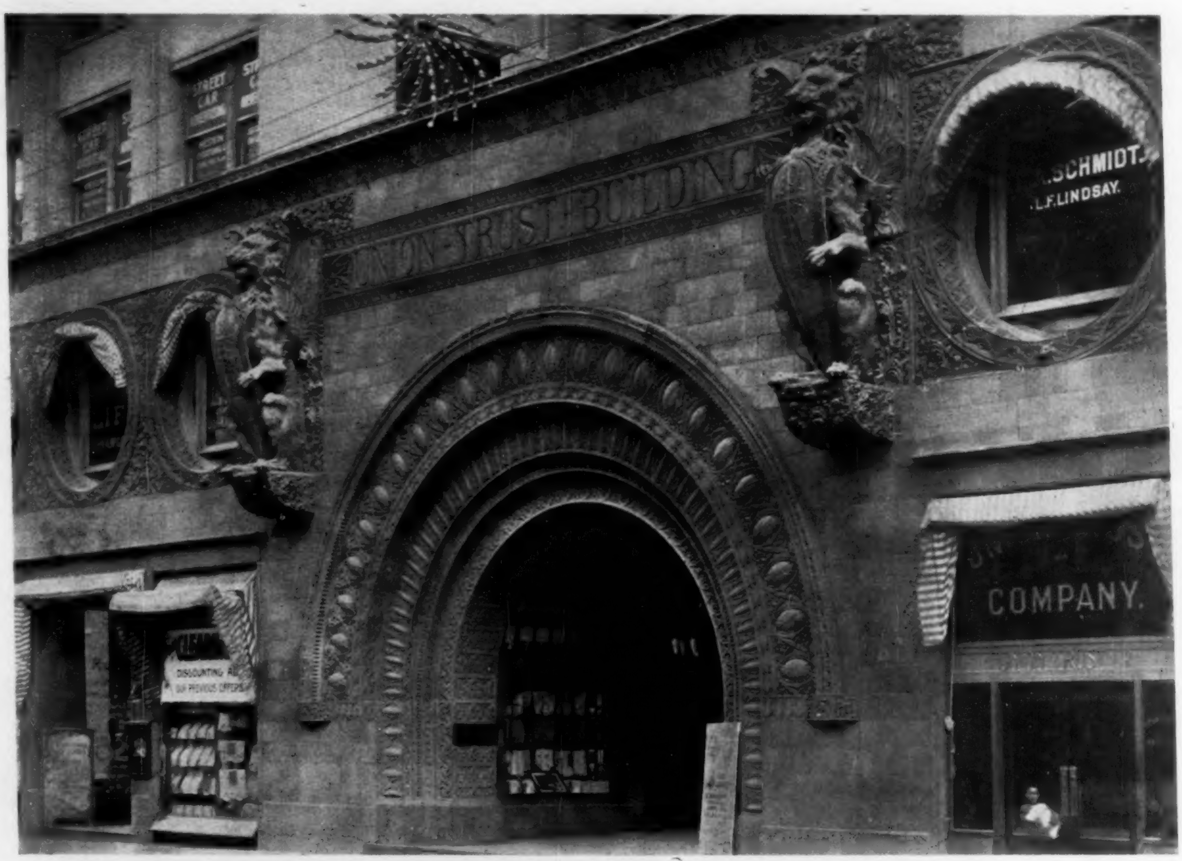
In Bell Place, Architects Barnett, Haynes & Barnett have just finished two residences costing about $40,000 each, one in stone and the other in buff brick with white terra-cotta trimmings; while F. C. Bonsack is taking figures on a stone residence for Mr. G. W. Brown, to be built in Portland Place.

Architect Taylor has just completed a five-story building on Broadway, on the site of the old Aloe Building, which was the scene of a fatal fire about a year ago, in which several firemen perished. The front is of red terra-cotta with large plate windows on each story, making an ideal business building and a decided improvement over the old rookery that was destroyed.

The building of the St. Louis Dairy Company, occupying nearly half a block between 20th and 21st Streets, by Architect Swasey, is a very interesting piece of red brick and half-timbered work. The basement is occupied by the stables, wagons, etc., while the upper floors are used for the offices and laboratory.

There are a number of old landmarks in which the advancement of modern progress has made it necessary to make alterations. Among these the old Davis Building, for nearly a quarter of a century the home of the large wholesale house of Samuel C. Davis, is being transformed into a department store, by Shepley, Rutan & Coolidge, at a cost of $50,000.

A movement is on foot to provide some permanent place for large gatherings, conventions, etc., and Architect Ramsey has prepared plans for a large amphitheater to occupy the north end of the Exposition Building, with a seating capacity of about 8,000, and in case of conventions, by using the arena, as many as 14,000.

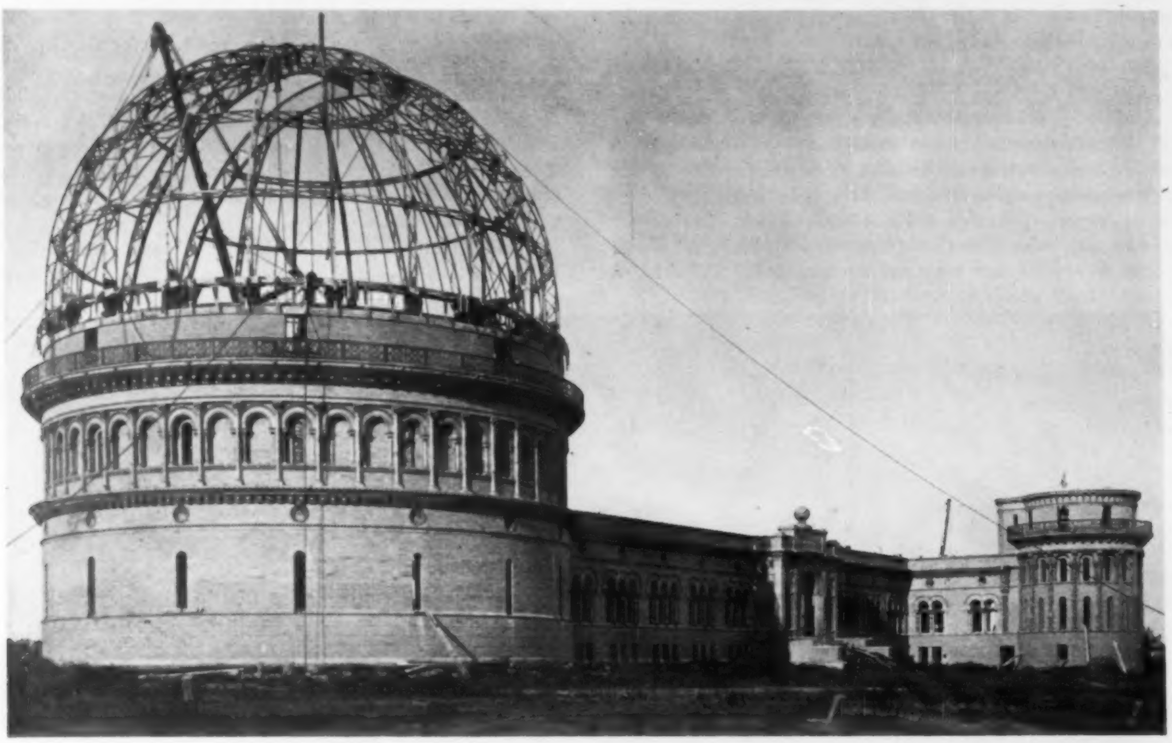


AN ENTRANCE IN TERRA-COTTA, UNION TRUST BUILDING, ST. LOUIS, MO.
Louis H. Sullivan, Architect.
The face and common bricks usedin this building were furnished by the Hydraulic Press Brick Company, of St. Louis.

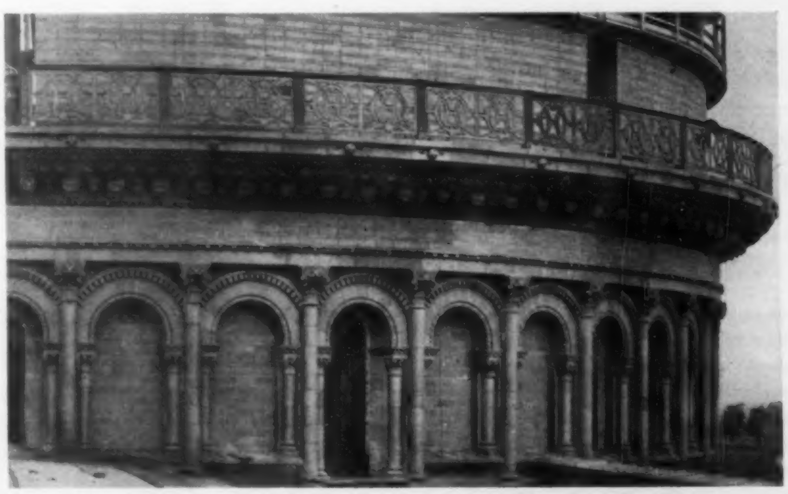
PITTSBURG.—The outlook in the architectural and building line for the coming season is very good. There is a movement well under way to erect a new Chamber of Commerce building at a cost of about $1,000,000. The Ninth U. P. Presbyterian Society of Allegheny are to erect a new church, to be of brick and stone, and cost about $20,000. Architect J. E. Allison is preparing plans for a new church of brick for the Methodist society of Vandergrift. Architect J. M. Alston has the new Insane Asylum for Allegheny City, which will be of brick. Architect Charles Bickel has the new German Turn Verein Building on South Side. Architect T. E. Cornelius is planning a small hotel for Coraopolis. Architect W. S. Sims has a fireproof laundry building on Fifth Avenue, Oakland; also a residence in the East End, each of which will cost about $20,000.

Mr. A. C. Boyd, of Boyd & Long, architects, died last month. Architects Shaw & Metcalf have dissolved partnership, Mr. Shaw continuing the business, and Mr. Metcalf returning to England.

Architects George Orth & Brother were successful in the completion for the new building for the Western Bank of Pennsylvania.



YERKES OBSERVATORY, GENEVA, ILL.
Henry Ives Cobb, Architect.
The buff brick used in this work was furnished by the Columbus Brick and Terra-Cotta Company, Columbus, Ohio. The architectural terra-cotta by the American Terra-Cotta & Ceramic Company, Chicago.



PORTION OF YERKES OBSERVATORY, SHOWING DETAIL.

MINNEAPOLIS.—A number of interesting things have developed, and we feel confident for next season, but matters are quiet now.

Among other interesting reports is that of a new Chamber of Commerce, to cost $300,000, which is to be voted upon by the Chamber. They have secured an option on the corner adjoining the present building. This is an important and much-needed improvement, a number of the larger corporations being unable to find quarters in the present inferior building.

A very interesting and unusual experiment has been made by the New England Furniture and Carpet Company during the past year, which culminated New Year's night. They wished to observe the tenth anniversary of their beginnings in Minneapolis in a fitting manner, and conceived the idea of building a neat, roomy modern house in one of our best suburbs, and giving it away, free of cost, to the lucky holder of the ticket selected in an open and fair manner from those issued during the year to their patrons, every $25 purchase entitling holder to a ticket. The house was designed by one of our leading architects, and is a gem in every way. As usual, the

winner was one of the smaller purchasers, holding but the one ticket, which was quite sufficient, of course. The lucky person was a lady who had purchased $27 worth of goods; a decidedly good investment, all things considered. The head of this company is a former Bostonian, Mr. W. L. Harris.

There has been considerable trouble and expense connected with the new electric plant and elevators at the Court House. An expert has carefully examined it and made an exhaustive report of his findings, but the elevator company does not take kindly to it naturally, and there is to be a joint investigation. Meanwhile, the service is unsatisfactory and the stairways are found safe and useful.

W. B. Dunnell has prepared plans for the new State Insane Hospital, to be built at Aroka, at total cost of some $900,000, one third of which will be required for a beginning.

The local G. A. R. posts have prepared a petition to our Park Commission requesting permission to erect a $35,000 building in Loring Park, to serve as headquarters and a museum for relics, etc.

The Regents of State University have asked the legislature for $100,000 to erect needed buildings during the coming two years: A chemical building this year, and for 1898 a fire-proof botanical building, a horticultural building, veterinary building and light and heating plant at State Farm.

NEW YEAR'S CALENDARS AND CATALOGUES.

To one who contemplates entering the clay-manufacturing business the new catalogue issued by the American Clay-Working Machinery Company, Bucyrus, O., will be found of invaluable assistance. There is a wealth of facts to be found from cover to cover, which seem to furnish all information upon the subject which could be desired. About every machine required in the manipulation of clay is illustrated and described; not only this, but the finished product itself as well as its application is shown in a most interesting series of illustrations. Such a work as this can be considered nothing less than an up-to-date journal of the industry it represents. Copies of this catalogue will be sent free on application to the company.

TERRA-COTTA DETAIL EMPLOYED IN GOODRICH HOUSE, TOLEDO, OHIO.
Coburn, Barnum, Benes & Hubbel, Architects.
Made by the Northwestern Terra-Cotta Company.

TERRA-COTTA CAPITAL, BOWLING GREEN BUILDING, NEW YORK CITY.
Made by the Conkling-Armstrong Terra-Cotta Company. An illustration of this building will be found in the company's advertisement, page v.

SAMUEL H. FRENCH & Co., Philadelphia, paint manufacturers and dealers in builders' supplies, have issued a most useful pad calendar, each leaf having a space for memoranda for every day in the week. A calendar of this sort once used becomes almost indispensable in office equipment.

MR. F. B. GILBRETH of 85 Water Street, Boston, has again issued his attractive calendar showing the time of tides. This, we presume, will not particularly interest our inland subscribers unless they are troubled with wet cellars.

THE "American Seal Paint" Calendar, issued by Wm. Connors, Troy, N. Y., in addition to the regular calendar features tells how "Uncle Sam" got his name, and shows his *modus operandi* of adding stars to the field of blue. The color scheme introduced is very attractive.

MR. F. W. SILKMAN, dealer in minerals, clays, colors, and chemicals, 231 Pearl Street, New York, has sent us a very handsome calendar, the top part of which has an engraving encircled by an embossed border, which adds much to the attractiveness of the whole. Each calendar has a different subject for illustration, which is taken from some well-known painting.

A NEAT little iron frame which has been treated by the Bower-Barff Oxidized or Rustless Iron Process holds the calendar issued by the L. Schreiber & Sons' Company, Cincinnati, to whom we are grateful for having remembered us.

R. GUASTAVINO has sent us a calendar which is interesting particularly because of the half-tone illustrations it contains, which show in a manner that almost explains his system, several of the prominent buildings wherein his fire-proofing tiles are employed.

NUMBER four of the series of "Minor Italian Palaces," which is being issued by the Cutler Manufacturing Company, Rochester, N. Y., contains seven plates from sketches made by Mr. Claude F. Bragdon, which, though grouped under the head of "Minor Italian Palaces," are nevertheless very interesting.

THE progress in material prosperity which this country has experienced during the past decade, no less than the increased possibilities of artistic manufacture, are well exemplified by the recently published Sketch Book of the Philadelphia and Boston Face Brick Company. This brochure contains over a hundred designs for fireplace mantels illustrated in greater part by photographic reproductions of actual work. The Sketch Book contains only fireplace

designs. They are well chosen, clearly and artistically presented, and offer a choice both in form and color suitable for a great variety of purposes. We may not habitually ascribe daintiness to such a material as pressed brick, but the brick forms are combined so cleverly that, especially in some of the smaller mantels, very dainty effects are produced; and though we might more naturally associate a brick mantel with a hall, a dining room, or a den, there are a number of photographs of charming mantels for parlors or boudoirs which leave little to be desired.

EXECUTED IN TERRA-COTTA FOR TREMONT TEMPLE, BOSTON.
Made by the Perth Amboy Terra-Cotta Company.

ALL THIS IS NEWS.

THE KITTANNING BRICK AND FIRE CLAY COMPANY, Pittsburg, Pa., whose yearly output of front brick in all shades will exceed seven million, have contracted with Meeker, Carter, Booraem & Co., 14 East 23d St., N. Y., to handle their Eastern business.

WALDO BROTHERS, the well-known building material dealers of Boston, have leased on a long term the Tudor Wharf property at Charlestown. This splendid piece of water-front property will be fully equipped for the better handling of the concern's extensive business.

THE PENNSYLVANIA ENAMELED BRICK COMPANY has recently supplied forty thousand enameled bricks for the Third Avenue Bridge, at Harlem, N. Y., Isaac A. Hopper, builder; also twelve thousand of same for the Police Station and City Court Building at Yonkers, N. Y., Edward A. Forsyth, architect.

THE PERTH AMBOY TERRA-COTTA COMPANY have just closed, through their agents, Waldo Brothers, the contract for the Proctor Building, Bedford Street, Boston, Winslow & Wetherell, architects. This is the most elaborate use of terra-cotta of any building scheme in Boston, the entire front being of terra-cotta from the sidewalk up.

G. R. TWITCHELL & Co., Boston, are supplying 100,000 red face brick for the new West End Schoolhouse, Boston, John Lyman Faxon, architect; Mead, Mason & Co., builders. Also 50,000 red face brick for the new schoolhouse, Dorchester district, Boston, E. W. Clarke, architect; W. S. Sampson & Son, Builders.

THE architectural terra-cotta for the new building for Mt. Holyoke College at South Hadley, Mass., will be supplied by the Perth Amboy Terra-Cotta Company through their New England agents, Waldo Brothers. The plans are by Gardner, Pyne & Gardner, H. P. Cummings & Co., contractors.

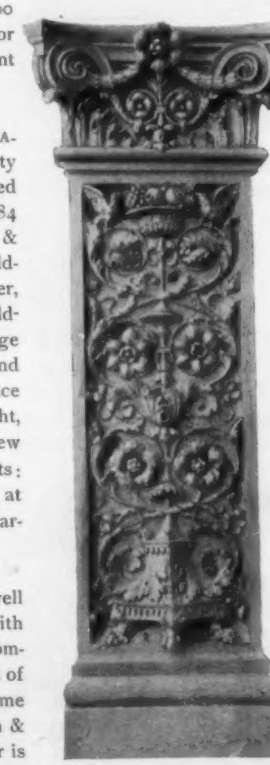
IN the reorganization of the Pennsylvania Enameled Brick Company, Seymour Van Santvoord becomes president; Henry Burden, 2d, vice-president; Wm. F. Burden, secretary and treasurer; Arthur E. Barnes, general manager; and F. P. Huston, New York representative. In addition to the manufacture of enameled brick, the company is now making a fine grade of white front brick.

THE PERTH-AMBOY TERRA-COTTA COMPANY will furnish the architectural terra-cotta on the following contracts: St. James Office Building, Broadway and 26th Street, New York City, Bruce Price, architect, the details of which will be very elaborate; Bell Telephone Building, 11th and Filbert Streets, Philadelphia, Chas. McCaul, architect; Western Electric Building, southeast corner Bethune and West Streets, New York City, Cyrus L. W. Eidlitz, architect.

THE TIFFANY ENAMELED BRICK COMPANY will supply the enameled brick for the "Fair" Building, northwest corner State and Adams Streets, Chicago, Jenney & Mundie, architects; George A. Fuller Company, contractors; Sherry Hotel, southwest corner Fifth Avenue and 44th Street, New York City, McKim, Mead & White, architects; Richard Deeves & Son, contractors. This order calls for about 270,000 White English size enameled brick.

THE COMMERCIAL WOOD AND CEMENT COMPANY, through their New York office, 156 Fifth Avenue, have closed contract with J. L. Ginn, Philadelphia, for 21,000 barrels of Commercial Rosendale cement for gun emplacement at the United States Fort Caswell, at the mouth of the Cape Fear River, N. C.

They have also closed contract with the Hartford Paving Company, Hartford, Conn., for 10,000 barrels of Commercial Rosendale for the United States gun emplacement at Portsmouth, N. H.



EXECUTED IN TERRA-COTTA FOR TREMONT TEMPLE, BOSTON.
Made by the Perth Amboy Terra-Cotta Company.

THE WHITE BRICK & TERRA-COTTA COMPANY, of 92–94 Liberty Street, New York, have just completed the terra-cotta for a candy factory, 84 to 90 Vandam Street, De Lemos & Cordes, architects; the Store Building, 78 Fifth Avenue, A. Wagner, architect; and Flushing Bank Building, at Flushing, L. I., S. E. Gage and W. J. Wallace, architects; and have closed contracts for residence at Bergen Point, N. J., A. F. Leicht, architect; chapel at Geneseo, New York, Heins & LaFarge, architects; and terrace for Tiffany residence at Westbury, L. I., W. J. Wallace, architect.

MR. J. FRANCIS BOORAEM, well known through his connection with the American Enameled Brick Company, has been admitted to the firm of Meeker & Carter, the new firm name becoming Meeker, Carter, Booraem & Co. The firm of Meeker & Carter is well known as being one of the largest operators in building materials in New York City, among the many manufacturers for which they are agents being the Staten Island Terra-Cotta Lumber Company, Woodbridge, N. J.; the Standard Fire-proofing Company, Perth Amboy, N. J.; Selden Brick Company, Erie, Pa.; Kittanning Brick & Fire Clay Company, Pittsburg, Pa.; Pennsylvania Brick Company, Oaks, Pa.; Williamsport, Brick Company, Williamsport, Pa.; Alumina Shale Brick Company, Bradford, Pa.; Garthe Roofing Tiles, Baltimore, Md.; American Enameled Brick & Tile Company, South River, N. J.; Farnley Glazed Bricks, Farnley, Leeds, England.

WE are very glad to print the following letter, which will explain itself. Such testimony from a well-known architect will do much toward placing the American manufacture of enameled brick in a right light before our architects and builders.

ILLINOIS CENTRAL RAILROAD COMPANY.

OFFICE OF THE CHIEF ENGINEER.
CHICAGO, Dec. 14, 1896.

TIFFANY ENAMELED BRICK COMPANY, CHICAGO, ILL.:—

Gentlemen: Having thrown open to the public the underground suburban station at Van Buren Street, which is said in all respects to be a phenomenal success, I feel I must extend my thanks to some of the material men and contractors that so ably assisted me in its construction.

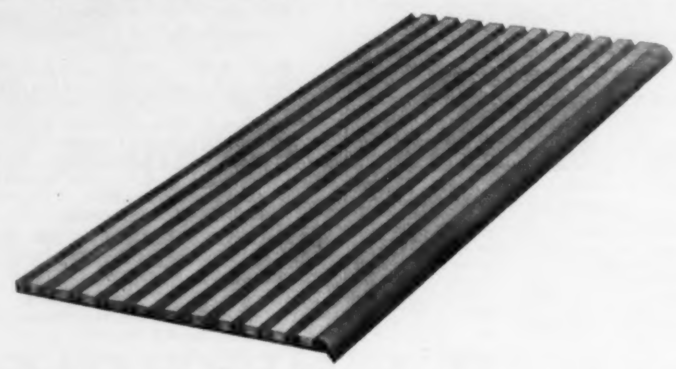
Your enameled brick (English size), which I used in this work, I have found are all you could possibly recommend them to be; and you deserve much credit from all, especially the architectural profession.

Not only are your brick very evenly enameled, and scarcely any difference in shade, but they are exceedingly hard, and I found could be perfectly ground for high-grade arch work, where I had to use some of them.

Taking pleasure in knowing that this lay-out at Van Buren Street Station, of your material, will be a great card for your firm, I remain,

Yours respectfully,
FRANCIS T. BACON,
Supervising Architect, Illinois Central Railroad Company.

DURABILITY AND SAFETY.



SECTION OF MASON SAFETY TREAD.

FEW building improvements in recent years have more quickly won deserved recognition from architects and builders than the Mason Safety Tread, which was introduced in Boston only about a year ago, and is now almost as well known as the Old South Church or the sacred codfish. The Mason Tread is a unique device, extremely simple and exceedingly effective. It is easily applied and adapted to a great variety of places, especially in our Northern climate, where stairs, entrances, and sidewalk lights are made slippery during so large a portion of the year by rain or snow.

The Mason Tread consists of a base of chilled steel with elevated ridges forming dove-tail grooves into which strips of lead are firmly pressed, the softer metal giving a sure foothold and the steel ensuring great durability.

The tread material is used in hundreds of places on our streets in the repair of worn Hyatt light borders, and the company is prepared to manufacture for new buildings sidewalk lights protected with their material. For internal use, Shepard, Norwell & Co. were among the first of our great retail merchants to appreciate the worth of the Mason Tread, and their grand staircase shows it to great advantage. Houghton & Dutton will have the stairways of their mammoth new building fully equipped with the treads, and in many other stores. In the Adams House and other principal hotels they are used upon stairways, entrances, and thresholds. They are used upon stairways in the City Hall, Quincy and Faneuil Hall Markets, Boston, upon the stone steps of all the police stations, and the company is at work upon a contract to place them upon the stairs in subway stations, where they will receive the severest test of all.

At the company's office, 40 Water Street, Boston, a sample stairway may be seen, showing the application of the treads to wood, iron, and marble. Mr. W. S. Lamson, of cash-carrier fame, is president of the American Mason Safety Tread Company, and Mr. Henry C. King, of Lawrence, treasurer. The factory is at Lawrence.

WANTED.

A FIRST-CLASS salesman in front brick and terra-cotta to sell goods in Massachusetts, Rhode Island, and Connecticut. Must have an acquaintance with the trade and a knowledge of figuring terra-cotta. Address C. S. S., Care of THE BRICKBUILDER.

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Is superior to any other Portland cement made. It is very finely ground, always uniform and reliable, and of such extraordinary strength that it will permit the addition of 25 per cent. more sand, etc., than other well-known Portland cements, and produce the most durable work. It is unalterable in volume and not liable to crack.

The Dyckerhoff Portland Cement has been used in the Metropolitan Sewerage Construction, Boston, and is now being employed in the construction of the Boston Subway, Howard A. Carson, Chief Engineer.

Pamphlet with directions for its employment, testimonials and tests, sent on application.

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UNEXCELLED IN QUALITY.

"The results of tests with standard quartz are far above the average of most cements."
CLIFFORD RICHARDSON,
Inspector of Asphalt and Cements,
Engineer Dept., Washington, D. C.

"This brand of Portland Cement was found especially qualified for the purpose of concrete casting on account of its perfect uniformity, intensive fineness, progressive induration after the first setting, and of its great tensile and crushing strength."
Vide Report of CARL A. TRIK,
Superintendent of Bridges, Philadelphia,
On Concrete Arch Highway Bridge over Pennypack Creek.

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IMPORTER AND SOLE AGENT FOR UNITED STATES, CANADA AND CUBA.

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By ROBERT W. HUNT & CO., Chicago.

	NEAT	2 TO 1	3 TO 1	4 TO 1
7 days' average	541.6 (28 briquettes)	156.7 (28 briquettes)	91.8 (85 briquettes)	51.3 (28 briquettes)
28 days' average	726.1 (28 briquettes)	271.6 (28 briquettes)	185.1 (83 briquettes)	135.2 (28 briquettes)
3 months' average	805.0 (14 briquettes)	356.7 (14 briquettes)	269.1 (42 briquettes)	180.5 (14 briquettes)
6 months' average	829.0 (7 briquettes)	390.8 (7 briquettes)	272.4 (21 briquettes)	220.2 (7 briquettes)
1 year's average	797.5 (7 briquettes)	398.8 (7 briquettes)	316.0 (21 briquettes)	229.3 (6 briquettes)

The above 503 briquettes were made from samples drawn from 252 separate barrels, out of 18,500 barrels of "ALPHA" Portland Cement. Such results were never equaled for .....Strength, Uniformity, and Sand-Carrying Capacity.

W. J. DONALDSON & CO., General Agents, **PHILADELPHIA.**

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BURHAM BRICK LIME AND CEMENT CO. LIMITED — BURHAM WORKS — TRADE PORTLAND CEMENT MARK — MURSTON WORKS — LONDON

ENGLISH PORTLAND CEMENT celebrated for Reliability, Chemical Purity, Great Strength, High Sand Carrying Capacity and General Uniformity. Quantity imported yearly far greater than any other brand.

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CIMENT PORTLAND — DE LA SOCIETE J. & A. PAVIN DE LAFARGE A VIVIERS (Ardeche) — FRANCE

French Portland Cement, the only material to use for setting, pointing, and backing LIMESTONE and GRANITE.

Will not stain and makes the strongest binder.

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The strongest, finest ground, and most uniform Cement in the world. Permits the admixture of more sand than any other, and is the best for mortar or stuccoing.

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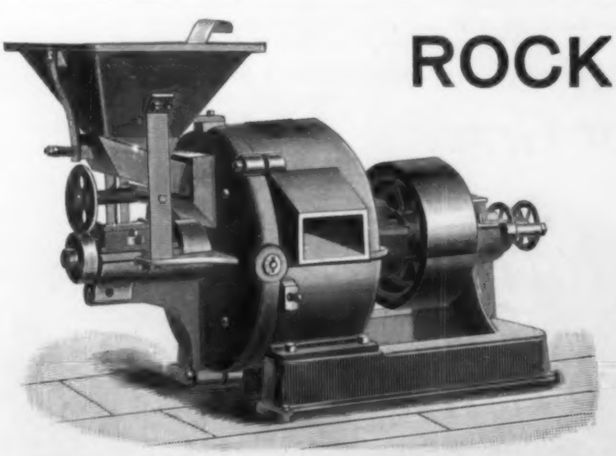

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The Chemistry of Pottery.

By KARL LANGENBECK.

Price, - - - $2.00.

It must be acknowledged that the author has carried out the work in a clear and systematic manner, and in addition to his own experiments has made use of the German work relating to the subject. The descriptions of clay masses and glazes are judicious and give in a few strokes a characteristic outline, so that the entire work must be considered very instructive. The reading matter of the book, which is free from bombast and is distinguished by solid knowledge of the subject matter, may be cordially commended.—*Chemiker Zeitung.*

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in all branches handled with a high degree of efficiency. Special attention given to the **auditing** and **straightening** out of the accounts of Builders, Contractors, and Clay Manufacturers. Best of references given from leading concerns all over the country who have employed my services. Fifteen years' experience as a public accountant and auditor. Address,

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The name of the Chicago, Milwaukee & St. Paul Railway has long been identified with practical measures for the general upbuilding of its territory and the promotion of its commerce, hence manufacturers have an assurance that they will find themselves at home on the Company's lines.

The Company has all its territory districted in relation to resources, adaptability and advantages for manufacturing, and seeks to secure manufacturing plants and industries where the command of raw material, markets and surroundings will ensure their permanent success.

Mines of coal, iron, copper, lead and zinc, forests of soft and hard wood, quarries, clays of all kinds, tanbark, flax and other raw materials, exist in its territory in addition to the vast agricultural resources.

The Chicago, Milwaukee & St. Paul Railway Company owns 6,168 miles of Railway, exclusive of second track, connecting track or sidings. The eight States traversed by the Company, Illinois, Wisconsin, Northern Michigan, Iowa, Missouri, Minnesota, South Dakota, and North Dakota, possess, in addition to the advantages of raw material and proximity to markets, that which is the prime factor in the industrial success of a territory—a people who form one live and thriving community of business men, in whose midst it is safe and profitable to settle.

A number of new factories and industries have been induced to locate—largely through the instrumentality of this Company—at points along its lines. The central position of the States traversed by the Chicago, Milwaukee & St. Paul Railway makes it possible to command all the markets of the United States. The trend of manufacturing is westward. Confidential inquiries are treated as such. The information furnished a particular industry is reliable.

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100 CITIES AND TOWNS WANTING INDUSTRIES

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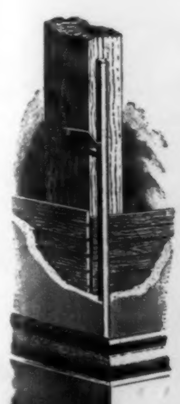

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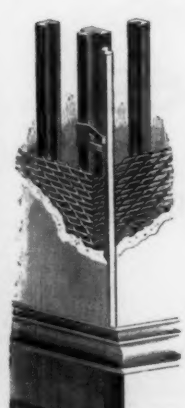

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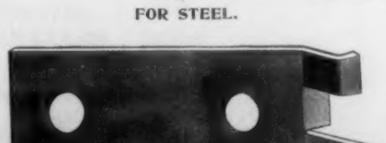

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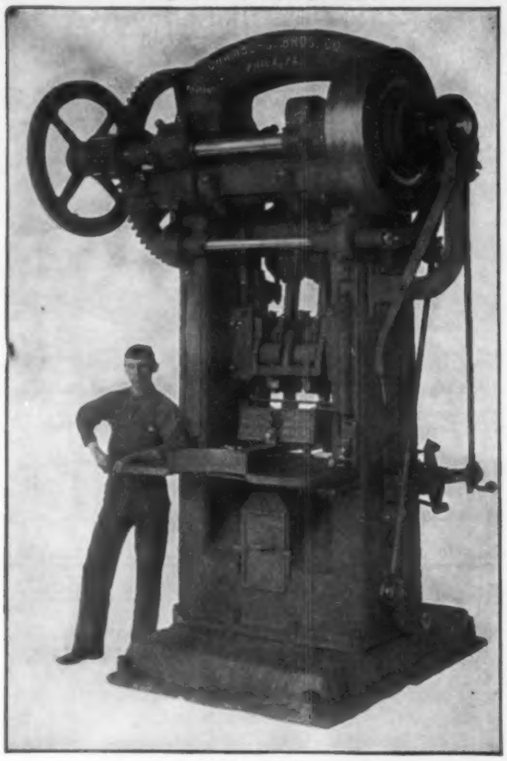

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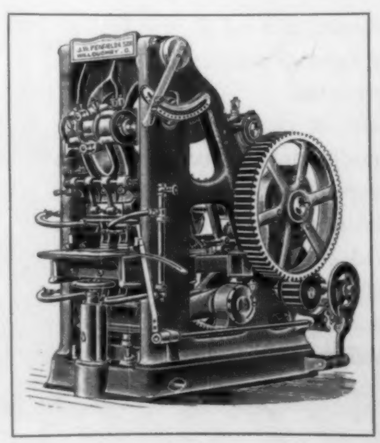

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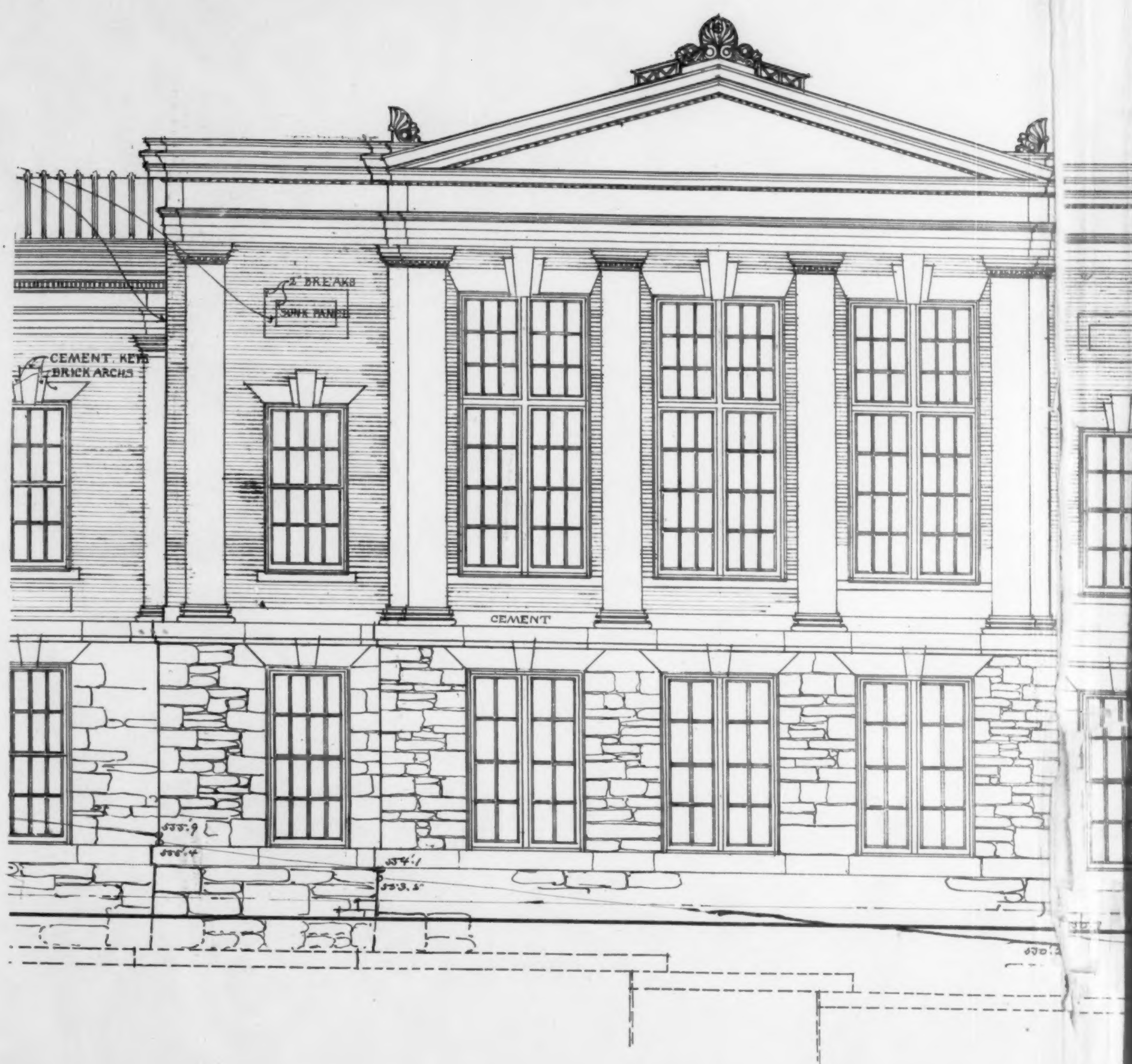

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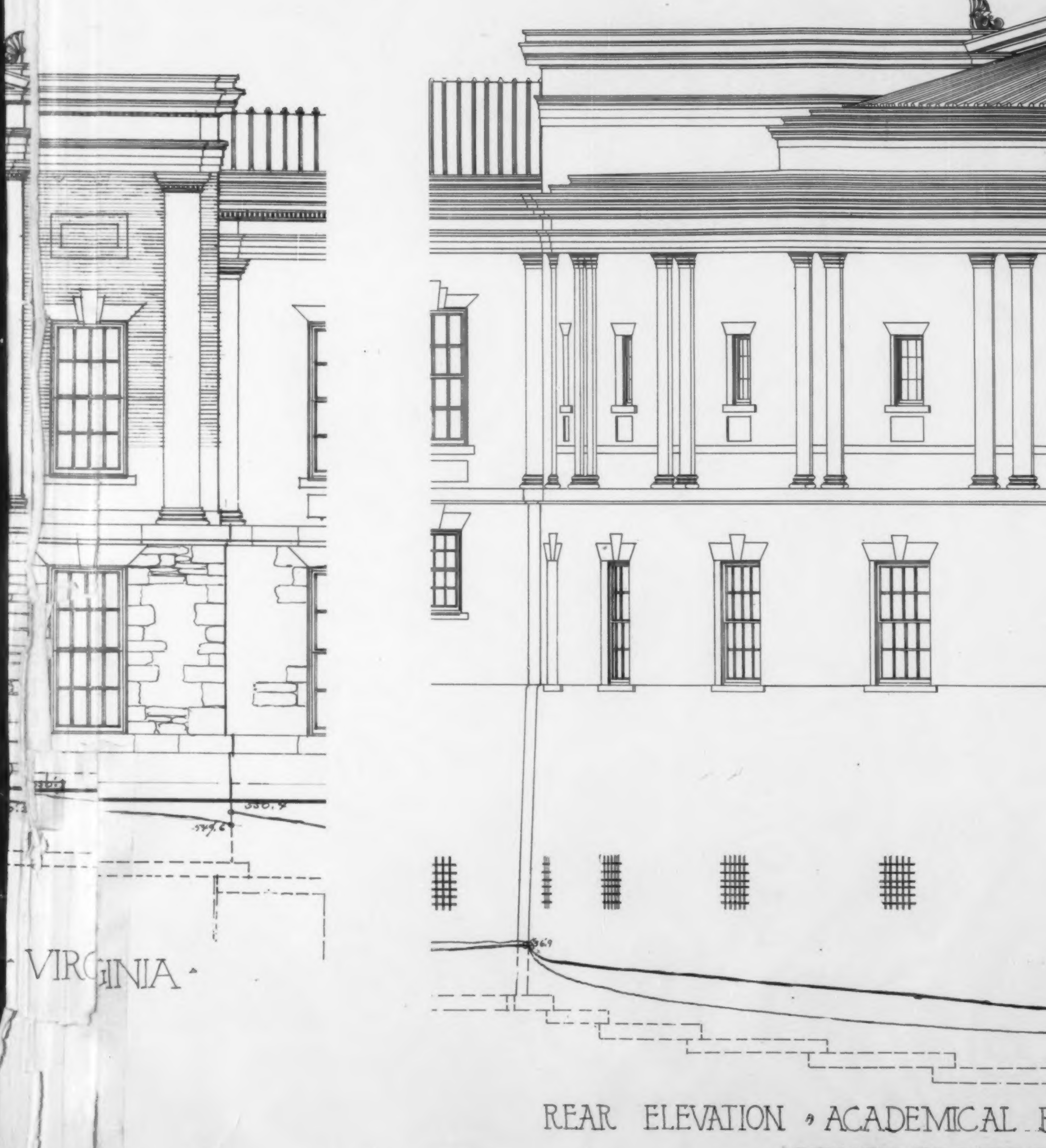

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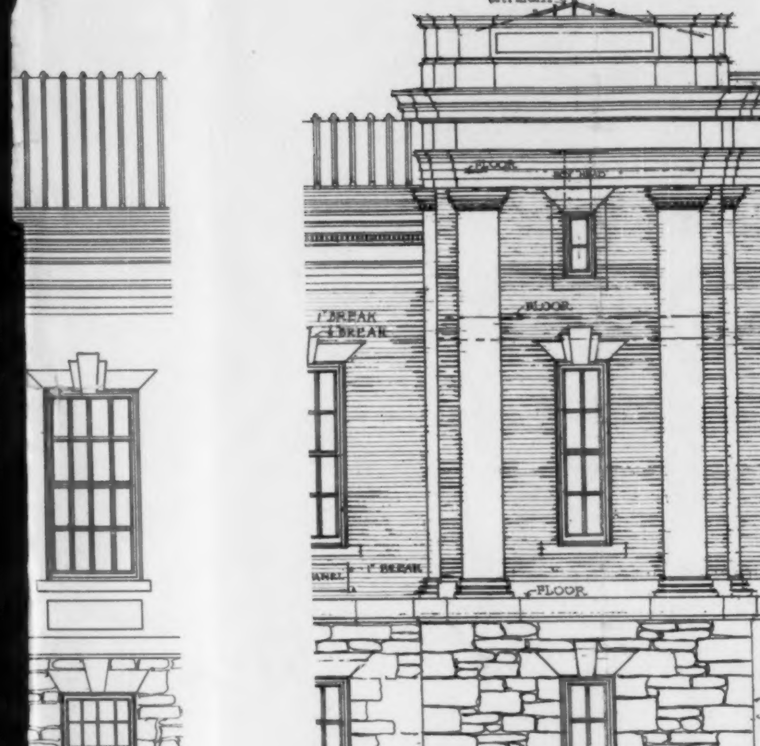
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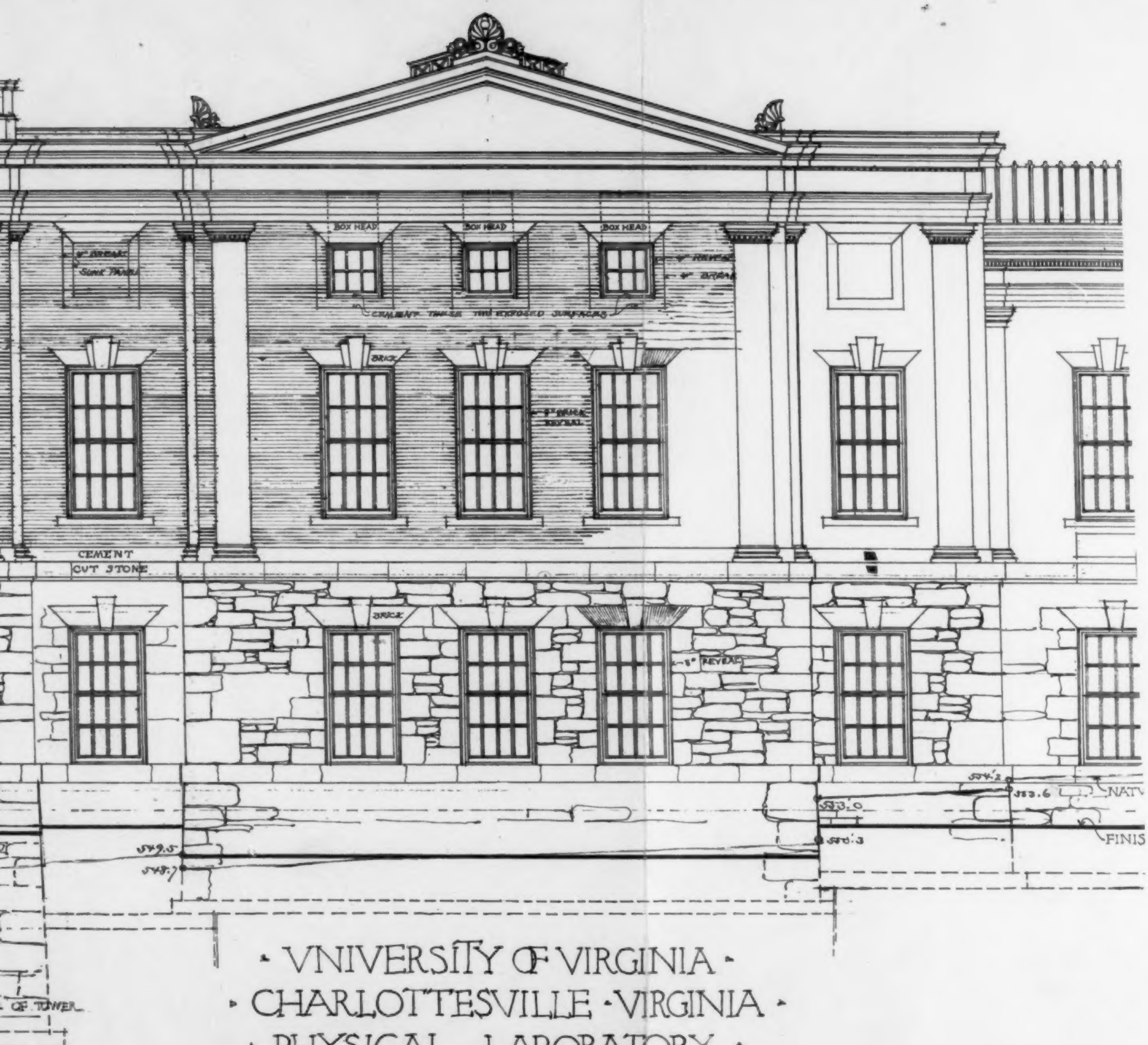

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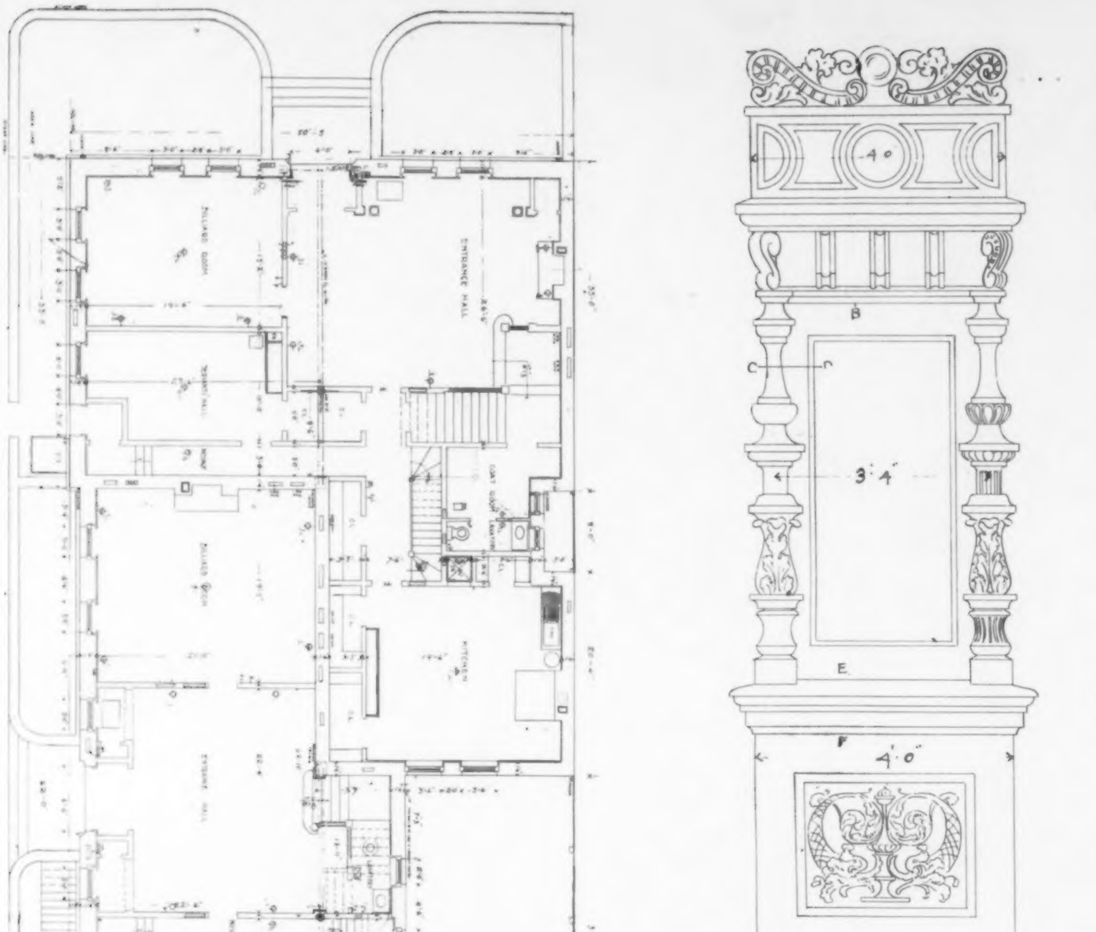
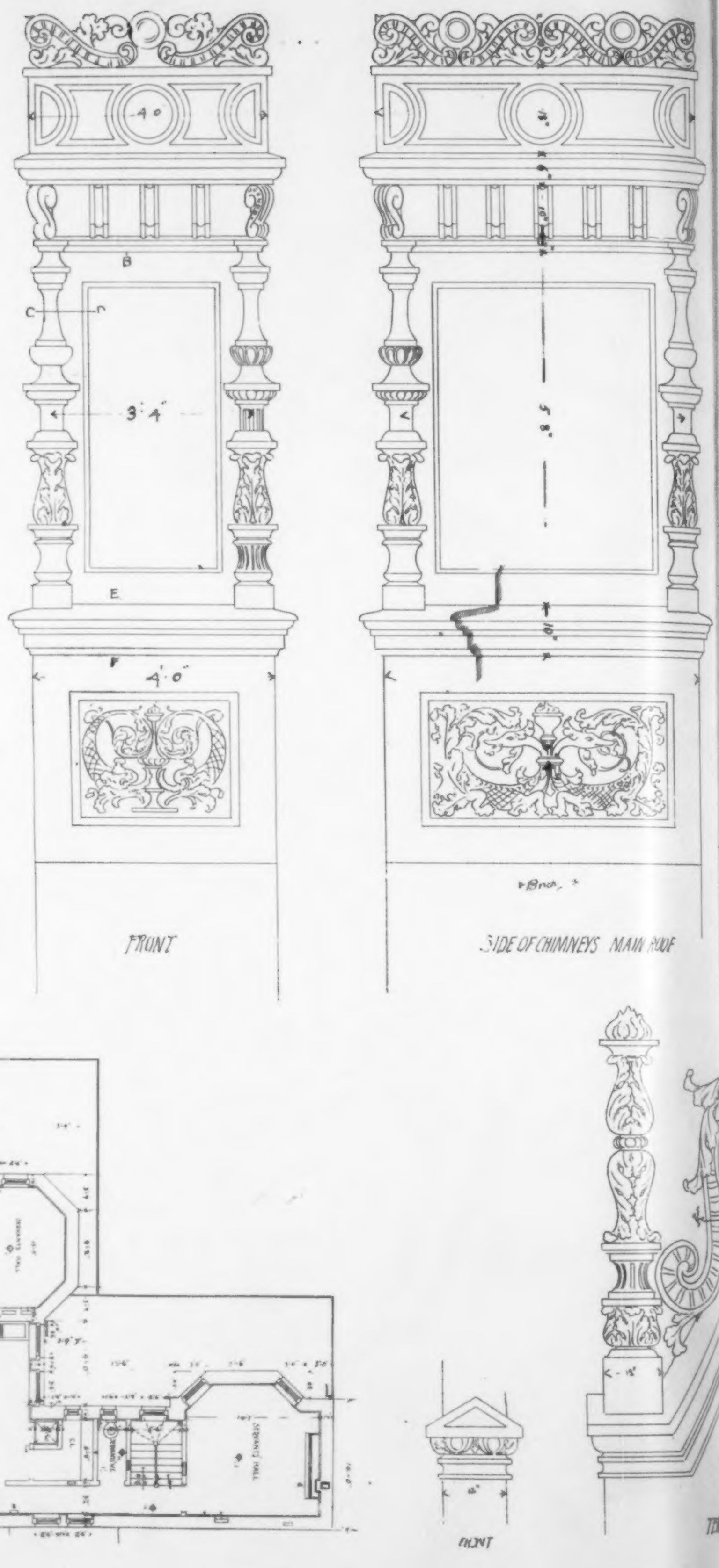


First Floor Plan.



DETAILS OF CHIMNEYS, WINDOWS, AND GABLE
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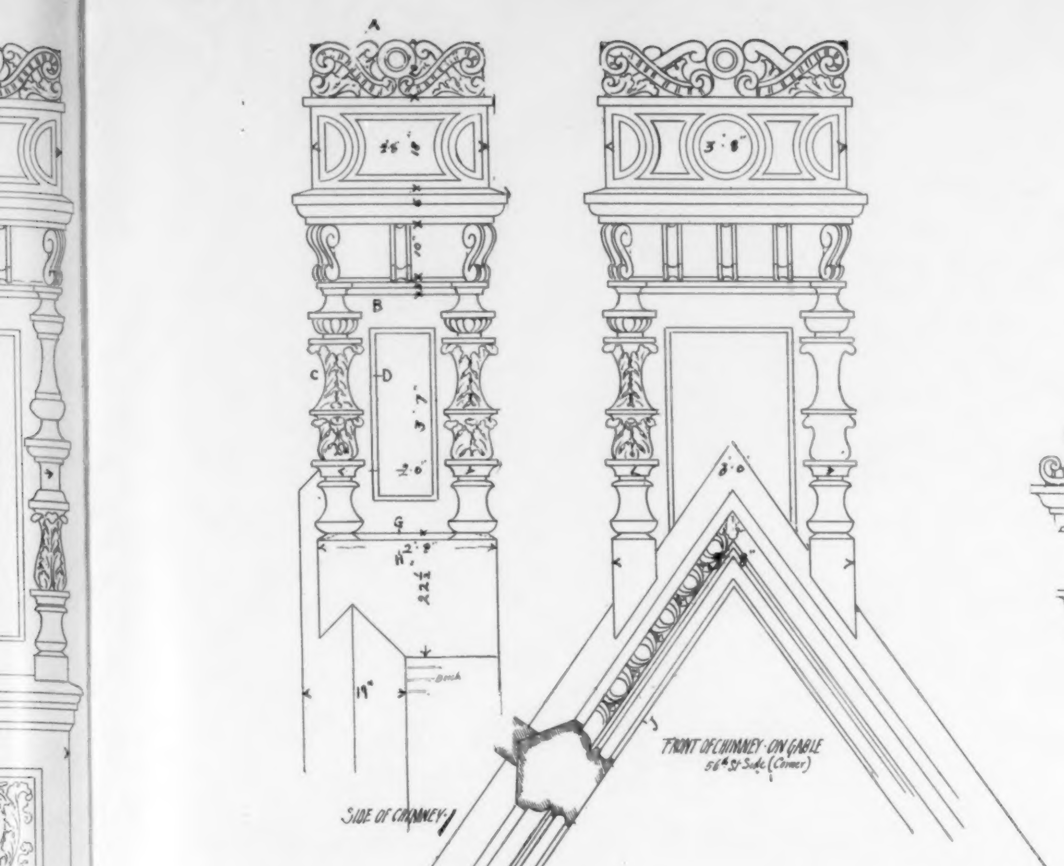
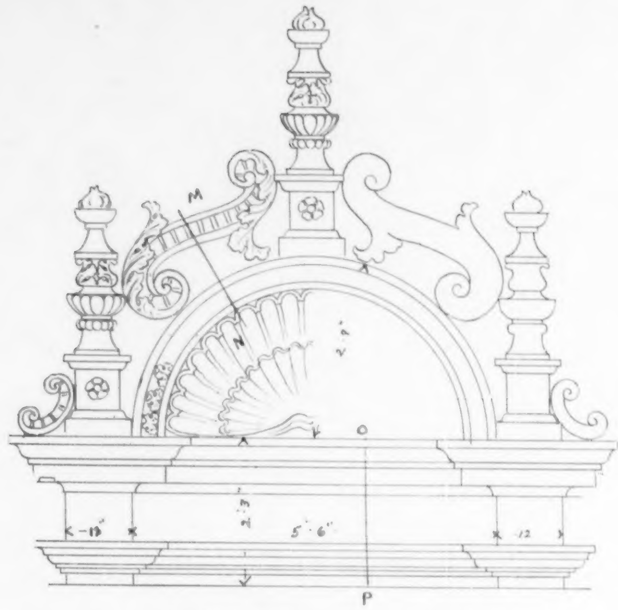
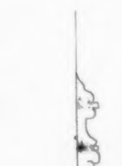
PLATES 19 and 20.



TERMINATION OF GABLES



WINDOW HEADS · 2nd BED-ROOM FLOOR
56th St. Side



SECTION

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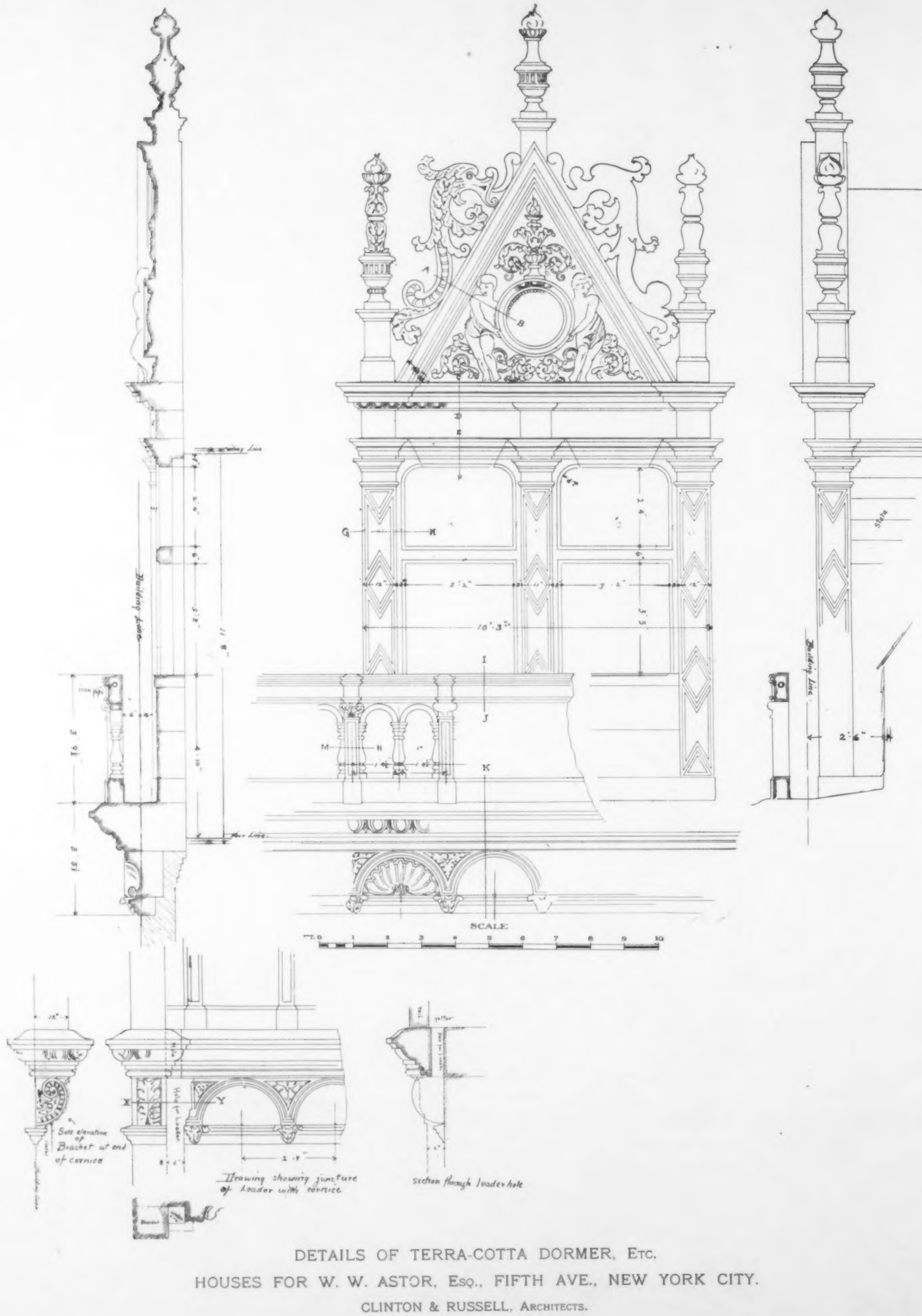

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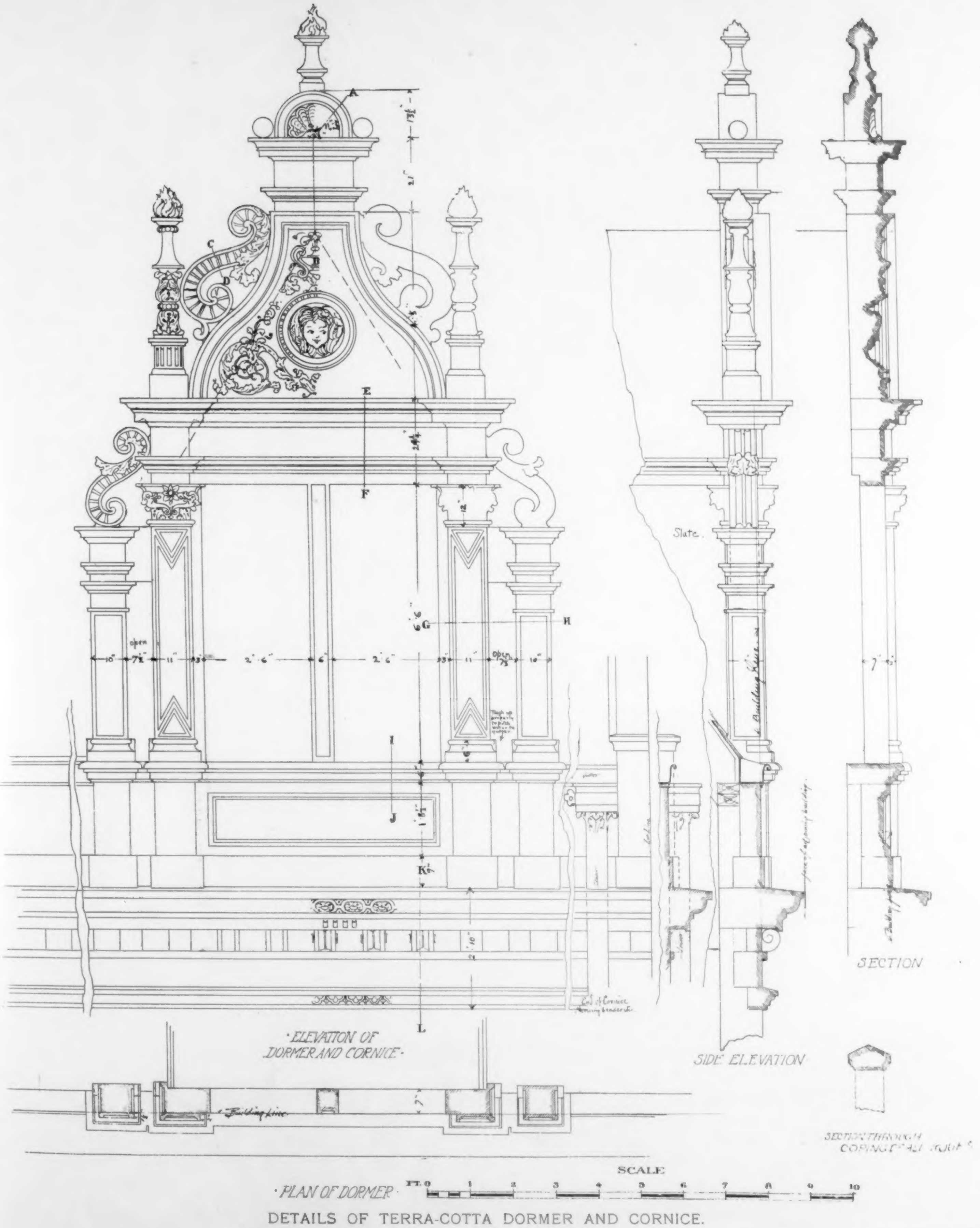

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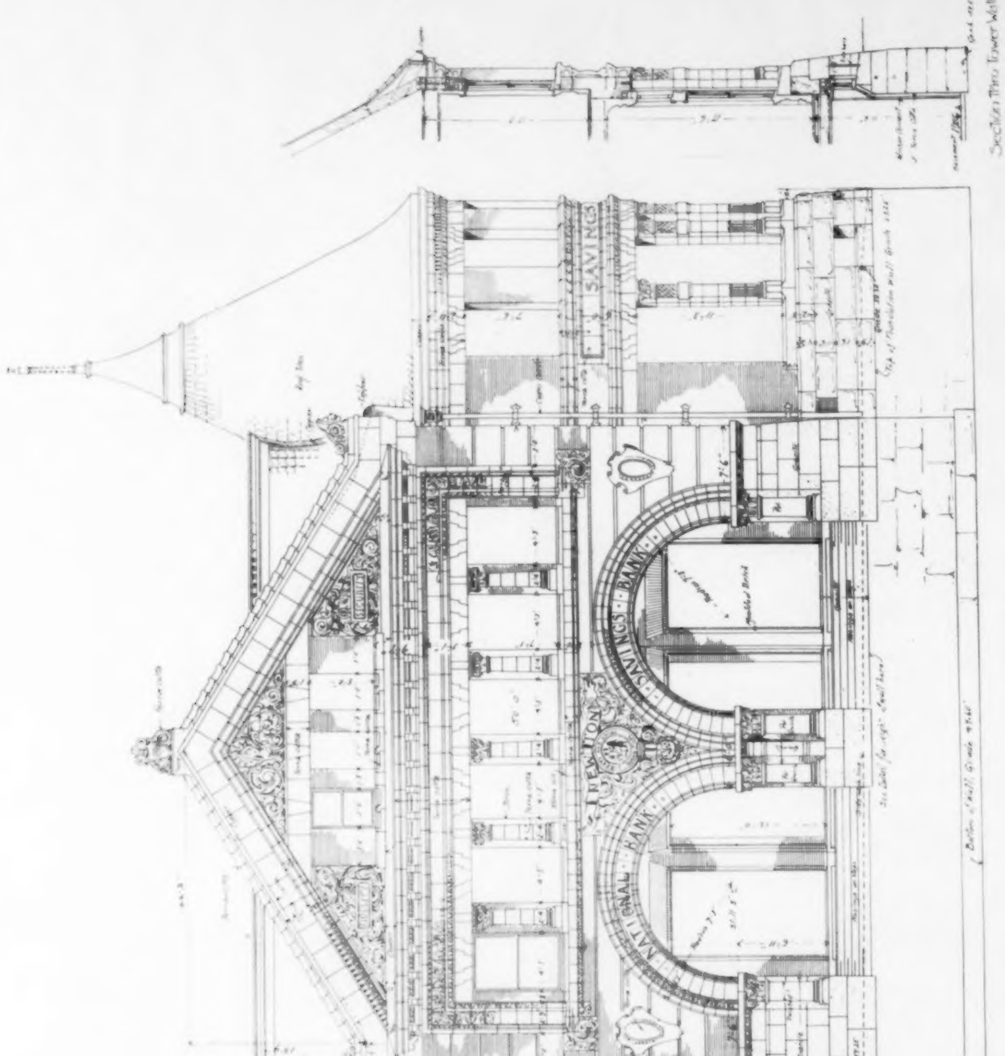

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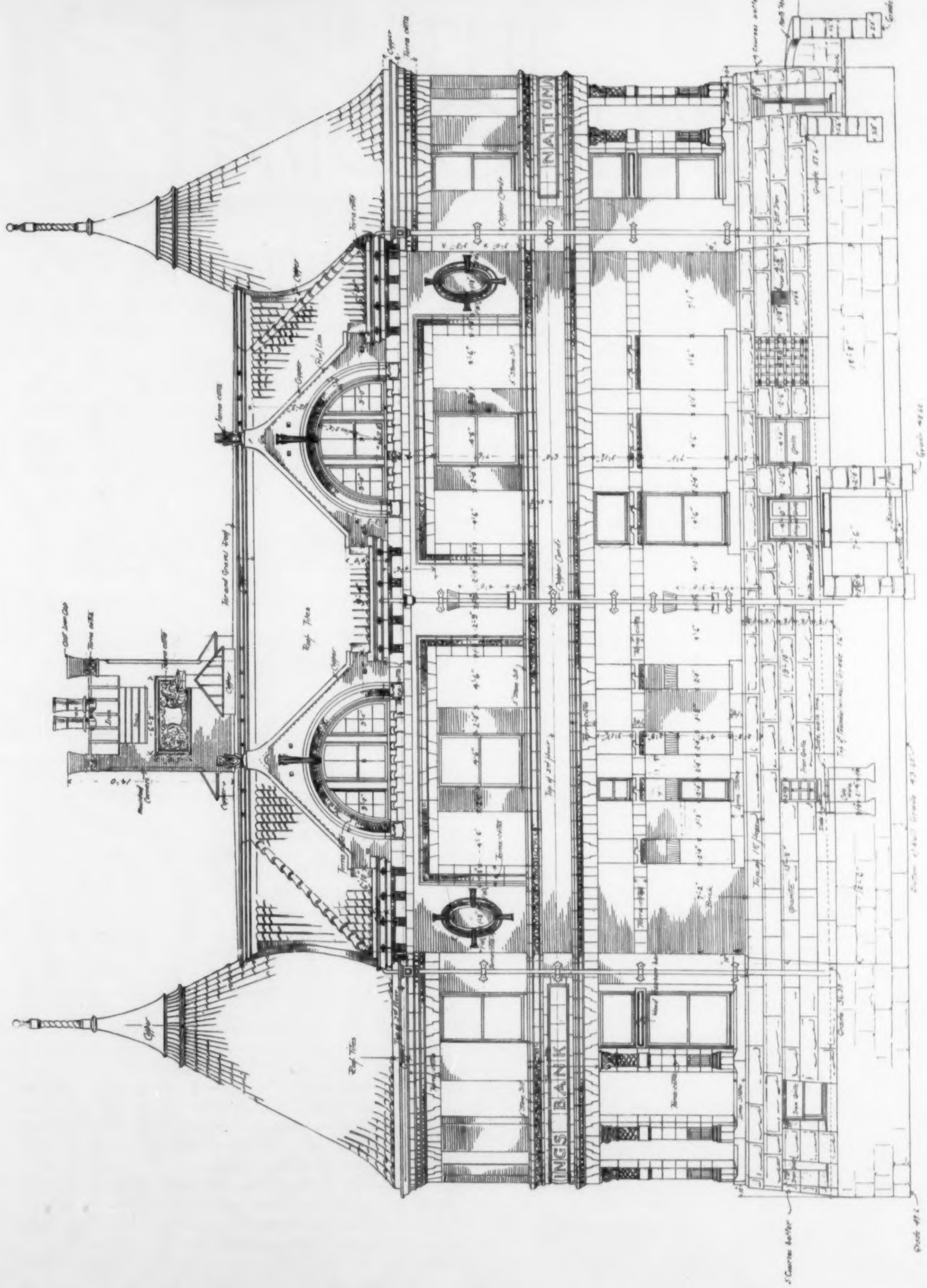

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